YEARBOOK of the ASSOCIATION of PACIFIC COAST GEOGRAPHERS

VOLUME 11, 1949

PUBLISHED BY THE ASSOCIATION AT CHENEY, WASHINGTON

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REPRINTED BY OREGON STATE UNIVERSITY PRESS, JULY 1967

MOTHER LODE, 1949*

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The year 1949 marks the centennial of a momentous migration to the newly discovered gold fields of California and the settlement of the mining country known as the Mother Lode. Certainly not great among Californian regions, nor currently outstanding in economic productivity, the Mother Lode possesses an individuality unmatched among the minor regions of the State for its picturesque beauty and its literary and historical associations. Located off the beaten track, the area preserves a good deal of the flavor of early days. Brick and adobe buildings constructed along simple, mid-nineteenth century lines are numerous in the surviving towns. Many retain the heavy iron doors and shutters, essential for protection against devastating fires which so frequently razed the early communities. Balconies of frame and ornamental iron work overhang narrow trail-like streets. In dozens of hamlets strung along the Lode structures erected in the 'fifties still house a few families or perhaps the village store or post office, while the ubiquitous and substantial Wells Fargo building is a prominent reminder of the part played by the express companies in the days before the establishment of banks.

But a modern overlay, particularly in the large communities, almost obliterates the earlier landscape. Such towns as Sonora, Jackson and Placerville affect the new look in modernistic lines of the recent architecture, in chain stores and neon lights; but their origin as mining camps is apparent in their outmoded, hemmed-in sites and the narrow, sinuous streets that serve as main highways.

A single exploitive industry laid the economic foundation during the pioneer period when the Mother Lode occupied an isolated frontier location. Recent years have witnessed a quickening of economic life in the utilization of long dormant resources. The diversification of economy and its improved stability parallel the trend noted in adjacent regions of California. (Note: See map of Mother Lode Country, p. 58.)

THE TERM MOTHER LODE, GEOLOGIC AND GEOGRAPHIC

The term Mother Lode, as used by the geologist, denotes the system of metalliferous veins in quartz and other rocks that occur in the folded and faulted formations underlying the lower slopes of the western Sierra Nevada. A more or less continuous belt of quartz veins occupies a fault zone approximately one mile wide, extending from Mariposa on the south to Georgetown north of Placerville, a latitudinal distance of one hundred twenty miles. It is from this system of rocks that all the gold of the western Sierra is derived--the surface placers worked during the

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*Presidential address of the Association of Pacific Coast Geographers, Vancouver, British Columbia, June 16, 1949.

first decade after the discovery; the older Tertiary auriferous gravels exploited by hydraulicking; and particularly the deep lode mines that maintained California's gold production until the second World War.

Attention was early directed to the massive outcrops of quartz in the placer zone, and a theory grew up that a single vein, "a mother lode," the ultimate source of all the gold, extended from one end of the belt to the other. The origin of the term points to early Mexican miners to whom the veta madre was familiar in many of the Mexican mining districts. According to Knopf, the first gold-quartz vein was discovered and opened in August 1849 on Colonel Fremont's Mariposa grant, but "...the term was first applied to the veins worked at Nashville, twelve miles south of Placerville, El Dorado County, in the latter part of 1850, or early in 1851."[1] The original belief of a single great persistent quartz vein traversing the state from end to end gave way in time to the established fact that the Mother Lode "...must not be considered as a continuous vein, but rather as a belt of parallel though some times interrupted quartz-filled fissures."[2]

On the other hand the term Mother Lode as applied to the geographical region is far more extensive than the mile-wide belt of auriferous rocks. In a general way the region overlies the Lode and its branching veinlets, but here and there it expands, reaching back into adjacent foothills or running out toward the Great Valley floor, thus attaining a width of ten to fifteen miles in places, contracting to a few miles in others. Like the Lode itself its major dimension runs lengthwise.

This attenuated region stretches from Georgetown and Coloma in El Dorado County to Mormon Bar in the county of Mariposa. The majority of the leading towns are situated on, or very near, the mother vein: Mariposa, Angels, Jackson and Placerville, but the important community of Sonora lies to the east, and Chinese Camp and Hornitos to the west, of the main veins. South of Mormon Bar the granites of the Sierra Nevada batholith are widespread and metalliferous rocks peter out. An extension of gold-bearing rocks and surface Tertiary auriferous gravels lies northerly of the Mother Lode beyond the deep canyons of the middle and north forks of the American River. It includes the important mining districts of Nevada and Sierra counties and is known as the "Northern Diggings," a part of the old gold-mining region of California, but usually not considered Mother Lode country.

Aside from the principal resource which determined its economy and history, the Mother Lode region occupies a transitional situation which profoundly affected its development. It lies between the Great Valley and the Sierra Nevada, two highly contrasted geographical regions--one a vast plain, the other a stupendous mountain. Its geography, therefore, is intermediate in character: certain features as climate, vegetation and fruit growing resemble similar features in the Valley; but mining and forestry relate it to the Sierra. The Great Valley and the Sierra Nevada are complementary regions and their increasing development involves the Mother Lode country as a transit area. Routes between Valley cities and trans-Sierran California cross the Mother Lode to utilize the passes through the high mountain barrier.

MOTHER LODE LANDSCAPES

Geographically, the Mother Lode country is a segment of the pied-

mont of the western Sierra Nevada. It has all the features of a transition region: land form, climate, vegetation and economy. Its western border merges very gradually into the level of the Great Valley floor; its eastern border passes more abruptly from hill land into mountain forms.

Two major landscape types may be recognized--one the rolling upland country of small valleys, grassy flats and undulating slopes; the other high mountainous forms, a succession of elevated ridges, protruding mountain shoulders and deeply incised canyons. One sees a sequence of these types on the long road that parallels the Lode from Mariposa to Placerville. Viewing the area from a commanding point above the gorge of the Stanislaus River just north of Columbia, the evenness of the horizon suggests a peneplaned surface. The uplift in late Tertiary and early Quaternary times resulted in change of level in the Sierra Nevada which induced canyon-cutting, a process that continues. The stronger rivers that cross the Mother Lode, therefore, are entrenched in canyons 1000 to 2000 feet deep. It is the recurring steep-walled gorge that produces the bold and rugged appearance of the mountain phase of Mother Lode relief.

But where erosion progresses at a more leisurely rate, open valleys and rolling hills on a plateau-like surface are the rule. Here streams are small and ineffectual, lacking the volume and power of rivers that rise in the high Sierra. They have, nevertheless, dissected the upland surface sufficiently to produce a hill and vale relief, aided by differential strength of the rocks. Highway 49 crosses the grain of the present surface and is a succession of ups and downs as the road ascends the ridges and dips into the valleys.

Altitude gains progressively from the Great Valley border on the west. From a scant 500 feet, elevation increases to 700 or 800 feet in the lower piedmont, then more rapidly through the Mother Lode belt up to the 3000 or 3500-foot contours where slopes steepen and the mountains are entered. Most of the major Mother Lode towns occupy an intermediate elevation of 1200 to 2000 feet which may well be considered the average altitude of the typical Mother Lode.[3] One is rarely able to sight the peaks and crests of the higher Sierra Nevada to the east owing to the successive rise of mountain range tier on tier. One notable exception is the view from Blossom Hill near Placerville where, under conditions of good visibility, the high country between Donner and Echo Summit passes can be glimpsed. But at Coulterville and Mariposa the view is restricted by enclosing hills creating an impression of little isolated valleys.

Elevation has a pronounced effect on the plant associations of the long west slope of the Sierra Nevada. A distinct zonation of vegetation types ranges from Lower Sonoran on the valley floor through Upper Sonoran and Transition, above which Canadian then Hudsonian pass into the Alpine zone near the highest elevations of the range.[4] The Mother Lode lies almost entirely in the Upper Sonoran, identified with the foothills and lower mountains in altitudes ranging from 1000 to 2500 feet. In places this vegetation type spreads upward to levels of 3000 and even 4000 feet, particularly at the south end of the Lode and on south-facing slopes. Grasses and shrubs--the familiar chaparral--are dominant with scattered Douglas fir and live oaks in the lower elevations. The digger pine (Pinus sabiniana), gray green and scant of foliage, marks the approach to the higher piedmont. In combination with toyon, wild lilac (Ceanothus) and manzanita, it is the characteristic tree throughout this belt.

The Upper Sonoran zone marks the beginning of a pronounced increment in precipitation. At Sonora the mean annual precipitation is 35.02 inches, an amount 20 inches greater than that recorded on the valley floor at Stockton. Placerville's rainfall averages 43.18 inches, compared with the 18.56 inches at Sacramento, directly west and 1850 feet below the foothill town.[5] Precipitation is sufficient for tree growth in the piedmont belt but its distribution seasonally is unfavorable. The period June to September averages less than 5 per cent of the annual rainfall, and the total for that period is under two inches. The dry season is long; this factor in combination with high summer temperatures, continuous sunshine and high rate of evaporation reduces moisture effectiveness and discourages growth of trees. Grasses and shrubs tolerate these conditions and constitute, therefore, the dominant vegetative types.

Above the Sonoran level (2500 to 3000 feet) the important forest belt is entered, but the best development of this association occurs in elevations higher than the Mother Lode. However, this forest zone supplies the lumber mills in the foothills and contributes substantially to the economy of Mother Lode towns. Western yellow pine (Pinus ponderosa), black oak (Quercus californica), golden oak, Douglas spruce and incense cedar compose in large part the commercially important Transition belt. Sugar pine (Pinus lambertiana) occurs somewhat higher, usually at elevations of 4000 to 5000 feet. The Sequoia gigantea, monarch of this outstanding forest belt, is distributed in isolated areas. The Calaveras Grove, just fifteen miles northeast of Murphys, and South Grove near the North Fork of the Stanislaus are magnificent stands of the Big Tree near the higher border of the Mother Lode country. The elevation of all these zones lowers with increasing latitude. Around Placerville and Coloma conifers are abundant as compared with the scant growth near the southern end of the Lode in the vicinity of Coulterville.

INDIVIDUAL LANDSCAPES

Mother Lode landscapes, as stated above, exhibit two phases: the undulating upland usually dissected by gulches and ravines, and the abrupt steep-walled canyons which breach the areas of moderate relief. Thus, in the 120-mile length of the Lode country, there are five areas which are flat enough to permit limited cultivation and extensive enough to support a few communities. Each of the five areas is bounded by rivers whose canyons set off the upland districts creating local regions that possess considerable individuality. These areas from south to north embrace first the Mariposa section which lies between the southern extremity of the Mother Lode and the Merced Canyon; second, the district between the Merced and Tuolumne rivers with Coulterville as center; third the Sonora area; fourth the upland area between the Stanislaus and Mokelumne rivers, and fifth the segment bounded on the south by the Mokelumne and on the north by the South Fork of the American River.

The Mariposa and Coulterville areas have many features in common. They are districts of scant population. The surface is uneven and becomes rugged as the canyon of the Merced River is approached. The Mariposa area is enclosed by wooded hills that merge on the east into the lower Sierra, while westward the elevation declines and passes into grass-covered slopes broken by ravines. Mariposa town retains a small importance owing to its location on the All-Year Highway to the Yosemite Valley. Hornitos, a few miles west, is a center of stock raising utilizing the fine natural pastures roundabout. Only a limited acreage is cultivated and that is

planted to grain. But residual olive, peach and fig orchards point to a former diversified farming.

The gorge of the Merced separates the Mariposa and Coulterville areas. Approaching the river the highway descends by switchbacks through Hell's Hollow to Bagby. Here the Merced has entrenched its channel 2000 feet below the surrounding upland. Steep slopes, verdant with dense brush and trees, drop abruptly to the stream. Visible along Peñon Blanco ridge is the white quartz of the gold-bearing lode, although here the exposure is metalless. The variety and complexity of the rocks is one of the most spectacular along the entire Mother Lode. Slates, serpentines and schists in an unusual array of colors are folded, crushed and tilted up on end in this zone of rock distrubance and ancient intrusion.

A jumble of ridges, low hills and occasional small flats intervenes between the Merced gorge and the Tuolumne River. The little Coulterville valley is but a somewhat wider expansion of one of the flats. Pocketed in enclosing hills it gives slight evidence in its present somnolence of the lively mining activity of the 1850's when every nearby gulch and canyon was placer mined. One speculates as to the possible sources of income since the decline of mining. A pleasant but remote hamlet, Coulterville is typical of many decadent settlements along the Mother Lode without resources or advantageous location for economic support.

Northward the surface lowers and flattens as it descends to the Tuolumne. The higher hills recede and slopes are gentle. In this vicinity the Hetch Hetchy aqueduct, carrying Tuolumne water to San Francisco, crosses the Mother Lode. Taking advantage of a 1400-foot drop near Priest's the water passes through the big Moccasin Creek power plant and out into a large lake, one of many such reservoirs along the lower edge of the Lode Country.

The occurrence of a series of level areas in combination with good highways favors concentration of population in this, the third of the inhabited sections. From the Tuolumne River to the Stanislaus a dozen little communities, all dating from Gold Rush days, are strung out along the main road. Jacksonville, Chinese Camp and Jamestown are strictly local centers, but Sonora, the second largest town of the entire Lode, supports diversified industries and in addition occupies a significant location as a route focus. Like Bret Harte's "Roaring Camp," Sonora lies in "...a triangular valley between two hills and a river." It appears to be built on terraces or in tiers, occupying the slopes that hem in the ravine. The business section strings along the valley bottom in the manner of a strassendorf while residential districts climb the slopes. In its site features and the compactness of its area, Sonora might well be a village in the Central Uplands of Massachusetts.

The most conspicuous land form in this segment is Table Mountain, a flat-topped ridge just west of Jamestown and Sonora. Rising a thousand feet above the flat, Table Mountain is a relic of the lava flow that filled a Tertiary river channel all the way to the Great Valley floor. Erosion has reduced the surrounding area leaving a steep-sloped mesa-like remnant capped by a 50 to 100-foot layer of basalt.

Although reminders of the once prosperous mining activity are fewer and less conspicuous in the southern Mother Lode than in the north, the land surface and stream channels have been literally overturned. The

earth has been trenched and excavated leaving deep holes, piles of rock debris and ridges of gravel and cobblestones as testimony of the human energy that was expended in the furious quest for gold. Digging, dredging, hydraulicking have left scars on the landscape, masked only in part by invading chaparral and forest.

This diversified and busy section is terminated by the gorge of the Stanislaus River. Slopes steepen, then drop 1200 to 1400 feet. Bridges today span the stream where ferries formerly operated so profitably in linking the Sonora-Columbia mining districts with those at Vallecito, Murphys and Angels Camp. Across the river the town of Melones and the abandoned Carson Hill mining development are southern outliers of the fourth of the developed areas of the Mother Lode. Angels Camp, Cherokee Flat (now Altaville), San Andreas and Mokelumne Hill are the main towns in this historic portion of the Mother Lode stretching from the Stanislaus to the Mokelumne River. Noteworthy for a long period of gold production and for literary assocations as well, there is little now to remind one of the stirring days. Cultivated lands today surround the quaint settlements of Murphys and Douglas Flat and a well traveled road crosses this section to the Calaveras Grove and on beyond to Ebbett's Pass.

Open woodlands, largely second growth, alternate with patches of grazing land all the way to the canyon of the Mokelumne, a stream which lacks the gorge-like features of the Merced and Stanislaus, although the canyon is pronounced at a higher point upstream. The river here fills the channel and obliterates the normal banks owing to the impounding of its waters by the Pardee Dam.

In the fifth and last of the core areas, that part lying between Mokelumne and American rivers, substantial mine equipment looms prominently, as one would expect in the most productive strip of the Mother Lode. In the twelve miles between Jackson and Plymouth gold exceeding $160,000,000 in value has been produced. According to the records "... this is by far the richest yield recorded along the Mother Lode for any sector of equal length, and is exceeded in California in total gold produced, only by the Grass Valley district of Nevada County."[7] Two of the biggest mines, the Argonaut and the Kennedy, opened in the 'fifties near Jackson, were profitably operated until 1942. Likewise the mines at Sutter Creek, Amador City and Plymouth, long thriving centers, continued mining until the government order terminated gold-mining when the United States entered World War II.

In spite of curtailment or virtual abandonment of mining, most of the towns in this section retain a surprising vitality and exhibit a fairly prosperous appearance. The demand for products of forest, range and farm increased during war and postwar years, and income from these sources helped to stabilize the area's economy. The production of lumber and wood products has long been important in El Dorado County centers, and in recent years deciduous fruit growing and fruit packing have added to the area's stability.

These industries center at Placerville, the largest town of the Mother Lode. The town is situated at the confluence of small ravines that converge on the narrow flat of Hangtown Creek. The pattern of the community was set in the 'fifties when Hangtown was a mining camp. Today the main street is cramped between in-facing business blocks. Traffic is heavy, for in addition to the large activity centering here, travel eastward

to points around Lake Tahoe and in Nevada goes up over Echo Summit Pass. On surrounding slopes thrifty orchards envelop the urban area. Bright red soil contrasts with the deep green of conifers in producing one of the most colorful landscapes along the entire Mother Lode.

North of Placerville the slopes are covered with ponderosa, incense cedar and fir, exploited for lumber wherever accessible by road. Small hamlets are scattered in the valley flats and on the gentler declivities. Georgetown, one of the most picturesque, occupies a hill site surrounded, like Placerville, by orchards and forests. In this vicinity the system of quartz-filled fissures of the Mother Lode terminates, with only scattered ore bodies farther north. A rugged area, largely primitive, extends beyond the Middle Fork of the American River. Yet every likely flat and bar along the countless streams has been prospected, for this is precisely the district where the earliest activity of the Gold Rush was centered.

Tiny Coloma lies in the valley of the South Fork of the American, and of all the Mother Lode hamlets is one of the least. Locust trees arch the main street and the ailanthus, the Chinese "tree of heaven" runs riot among roofless buildings of brick and stone, survivors of the 'fifties. A few residences of later vintage house the town's few residents. Makeshift stores serve motorists who stop briefly to view the site of Sutter's sawmill and the place where the actual discovery of gold occurred. High on a hill overlooking the site stands the monument of James Marshall whose find set in motion the world-wide migration which led to the gold fields of California.

SOME HISTORICAL ASPECTS AFFECTING PRESENT ECONOMY

Though locally varied, these landscapes are repetitious not only of physical feature but of culture pattern as well. The similarity in culture stems from the simultaneous occupation of all parts of the Mother Lode and the identical economy, particularly during the first decade of settlement. The repetitive features are a heritage of the past; divergencies represent, in most cases, aspects of independent development in recent years. In 1848-49 the impetus of discovery and the rapid exploitation of alluvial gold carried the arriving hordes into all the creek bottoms, gulches and ravines the full length of the Mother Lode and into the "northern diggings" and the Trinity-Klamath mining area as well. Settlement was immediate. Camps mushroomed into good sized communities and so some became towns with even a few of life's amenities.

Mining was confined not alone to working stream channels and bars. By 1850 or '51 quartz or lode mining was undertaken. Hydraulicking was employed in reducing Tertiary gravels, and dredging, unsuccessful at first, brought into play by the mid-fifties the major types of mining utilized subsequently in all the gold districts of California. But the cream was soon skimmed. From a total value of ten million dollars mined in 1849, production climbed in 1852 to 81 million dollars value for the entire State. A sharp reduction was recorded the following year, then a partial recovery; but by 1855 output plunged abruptly into a permanent decline.

The early placer mining was largely a matter of independent enterprise, at most the cooperation of a few individuals. It required little or no actual investment other than simple tools. The other methods, in par-

ticular lode mining, involved considerable capital and employed few laborers. The extension of quartz mining, therefore, did not take up the slack in labor supply resulting from the petering out of placer mining of river-bars and gulches. In consequence

> "...when the day of disillusionment came, the tens of thousands (of miners) were speedily reduced to thousands. Some of the crowd stampeded off to new El Dorados. Others sought new occupations. The rest returned to their old homes. Behind them they left, like a courageous rear guard, a scattering of still vigorous camps, whose claims still paid richly. But they also left ..... ghost towns and deserted villages that stood as lonely witnesses to this truth: mining is a good way to pioneer a territory, but a poor way to hold it."[9]

In the period 1860 to 1870 the population was reduced by half in most of the Mother Lode counties. Agriculture and stockraising, industry and trade were expanding in adjacent valleys and on the coast, and offered occupational opportunities to displaced miners. California was entering upon a period of diversified and stable economy, in which the Mother Lode was destined to share, although remoteness and poor communications long retarded complete participation.

Mining maintained a moderate production, bolstered by the output of several large lode properties. But the total gold production declined steadily. Statistics for the individual Mother Lode counties are available beginning in 1880.[10] The reports for the period 1880 to 1930, inclusive, show that gold mining increased slightly until 1900, then fell back in 1930 to the lowest production value recorded to that date.

PRESENT ECONOMY OF THE MOTHER LODE REGION

Mining

The vicissitudes of gold mining in California are reflected in the fluctuating production throughout the century 1848 to 1948. The peak production was reached in 1852 when the gold mined in the entire State was valued at $81,000,000. Then followed decline, at first steady, then rapid until the low point, under $10,000,000, was recorded in 1930.[11] The slight increase in the early 'thirties marked the beginning of a brief revival bolstered by passage of the Gold Reserve Act of 1934 which fixed the weight of the gold dollar and set the value of gold at $35.00 a fine ounce, an increase of $14.33 over the price paid in 1932. The apparent increased production of 1934 and subsequent years is a reflection of this price increase and consequent stimulation of gold mining. The rise continued until 1941 when the value of gold mined in California was the largest since 1862.

Then came a sharp decline in both placer--in the main dredging--and lode mining, owing to increased difficulty in obtaining supplies and labor. On October 8, 1942, the War Production Board's order closed down most of the gold and silver mines of the State.[12] The large lode mines were boarded up after the removal of equipment essential to the war effort and the properties were put under guard. The period of idleness caused great damage to some of the mines. Cave-ins and flooded shafts and tunnels placed many beyond rehabilitation in view of high labor costs. Such is the case of the famous Argonaut Mine near Jackson. From the lowest levels a mile underground, shafts have filled with water

up to the 4000-foot level. A year ago the mine was dismantled; equipment and machinery were brought to the surface, and the property offered for sale.

The limitation order was rescinded in August 1945, but the gold mines did not resume production as had been anticipated. The high cost of labor and its scarcity in combination with shortages of material and supplies, high taxes and the fixed price of gold have made gold mining unprofitable since the war. Of California's highest ten counties in gold production for 1946 not one was in the Mother Lode. In that year the total production for the five Mother Lode counties was less than $600,000, yet this amount was twice the production for the year 1945. The year that marks the centennial of the Gold Rush finds mining at a standstill. Millions of dollars worth of recoverable gold undoubtedly still remain in vein and placer deposits, but "...the demand for industrial materials, increasing with the State's growth, is fast overshadowing the older, more romantic mining industry."[13]

Current reports, however, suggest reviving interest along the Mother Lode. The Central Eureka at Sutter Creek is undergoing repair and modernization. A few mines in Mariposa County are again active.[14]

Other metallic substances are recovered but their present volume and value are small. Lead, silver and zinc occur in association with gold. They contributed slightly to the total production of metals in 1946. Some non-metallic materials are significant, especially those derived from limestone. The lime and cement plants centered in El Dorado and Calaveras counties are among the Mother Lode's largest industries. Copper has been mined spasmodically since 1861 at Copperopolis, particularly during the two World Wars. In 1946 Amador and Calaveras counties produced almost four million pounds.[15] That copper yielded in 1946 a larger return than gold is a commentary on the present depressed position of gold in the Mother Lode.

Utilization of Nearby Forests

The decline of mining as the Mother Lode's major industry has been accompanied by increased utilization of the forests. The recent war was responsible for shutdown of the mines, but it stimulated demand for forest and range products. Lumber production in the Mother Lode counties almost doubled in the period 1938 to 1947,[16] and the income from grazing, dependent in part on mountain pastures, increased substantially. Recreation also contributes to the stabilization of the area's economy.

Without commercial timber itself, the Mother Lode country is an outlet for forest products of the adjacent Transition zone. All Mother Lode towns are within ten to fifteen miles of the west boundary of the Stanislaus and El Dorado National Forests. Valuable stands of ponderosa and sugar pine, white fir, incense cedar and Douglas fir are found only a few miles inland at elevations 3000 to 5000 feet, and Jeffrey pine and red fir somewhat higher. Commercially valuable trees thin out above 6500 feet, although lodgepole pine and western white pine occur in inferior stands.

Areas accessible to the older mining districts generally are logged off. But a substantial second growth now clothes many of the slopes, and profitable exploitation of these timber lands is expected in the future.[17] In fact, during the war years second-growth ponderosa pine was cut for

piling for coast shipyards and for military installations in the Pacific. Poles for power lines are now being harvested.

In 1946, one hundred ninety sawmills were operating in the five Mother Lode counties with a combined production of 521,500,000 board feet. The number of mills is expected to decrease as small wartime outfits, avid for profits, exhaust available stands of timber. Seven established companies are operating within the Stanislaus National Forest and an equal number in the El Dorado.[18] These mills are near the bigger Mother Lode towns, although those at West Point and Confidence are in the higher country east of Jackson and Sonora. In addition to heavy building and mine timbers, specialty products are manufactured: sash and door items, veneer, molding and boxes, the latter for the Great Valley's important fruit-packing industry.

The uncontrolled cutting of timber during the Gold Rush, and more recently on privately owned lands, removed the original forest adjacent to the populated areas. Under the administration of the U. S. Forest Service an enlightened program of conservation is now in effect. Timber is cut on a sustained yield basis. The demand for forest products in California has been insatiable in recent years, augmented by war demands and a vast building expansion. Although the central Sierra Nevada is by no means California's outstanding lumbering area its proximity to Valley markets places it in a favorable position, and the Mother Lode region benefits economically from an intermediate location between producing and consuming areas.

Grazing

Mild winters and natural pasturage encourage grazing in the foothill belt. Established in the early years of the Gold Rush, stock raising was stimulated by local food demands and the distance from supply centers. Today the situation is reversed, for in addition to supplying local demand animals raised in the foothills go to Valley markets. In all the Mother Lode counties present returns from livestock exceed those of field and orchard crops. Beef cattle take the lead.

The emphasis on animal rather than crop production is related to geographic conditions: relief, water supply and climate. The rolling nature of the piedmont is poorly adapted to field irrigation, thus hampering the development of cultivated land except for dry-farmed and high-return orchard crops. Sources of water for large scale irrigation are limited because the large rivers are incised in canyons and the small streams are undependable in the critical dry season. On the other hand, the mild temperatures of winter and the availability of natural forage in the spring encourage livestock raising. Moreover summer pastures are extensive in the nearby forests. Two ranching systems have evolved in the foothill belt conditioned by availability and source of summer feed; they include the non-migratory herds and flocks maintained on ranches the year round, and migratory stock supported entirely by grazing or grazing supplemented by crop feeds.[19]

It is the migratory stock that utilizes the high mountain pastures. A practice recalling Old World transhumance has developed in the movement of herds and flocks into the Sierra Nevada, a practice not limited either to the west slope or to the Mother Lode segment of the Sierra. John Muir in "My First Summer in the Sierra" gives a picture of the slow movement of

flocks from the desiccated pastures in the Valley to verdant meadows near Yosemite. The method of transfer in late years has been modernized. Today animals are transported largely by truck.

During the 1948 season 22,000 cattle and 16,000 sheep were accommodated on government lands alone within the Stanislaus and El Dorado Forests. Beef and dairy cattle, horses and sheep are involved in the seasonal shift to upland pastures, but sheep appear to be the stock historically most important, particularly in the more southerly areas. Grazing lands up to 9000 and 10,000 feet are normally the goal of Valley sheep. The grazing season opens progresively May first, June first, July first and August first depending on elevation. It usually closes in late September or some time in October.

Recreation

There is much in the Mother Lode country itself attractive to tourists--the places made famous by Mark Twain and Bret Harte, historic Coloma and dozens of early settlements now a century old. An even greater attraction is the neighboring Sierra Nevada, recreation area par excellence. Roads to Lake Tahoe, the Yosemite National Park and Big Tree groves cross the Lode to the long-established resorts on the east and west slopes of the Sierra.

Within the Stanislaus and El Dorado National Forests recreational facilities are varied. They contribute to the economy of the foothill belt, particularly throughout the warm season. Summer homes occupy private and public lands; camps for youth organizations are maintained. The cool, bracing atmosphere offers a retreat for Valley and coastal cities; Stockton, Sacramento and Berkeley maintain municipal camps in these national forests. Winter sports grounds in the Echo Summit and Yosemite areas are accessible by all-year highways that pass through Placerville and Mariposa.

Certainly intermediate location between two highly contrasted natural regions redounds to the financial benefit of the Mother Lode. Accommodations, supplies and services for transient motorists yield a substantial income.

Agriculture

The enormous demand for food during Gold Rush days and high food prices encouraged a considerable number of small farmers to take up homesteads in the foothills and other men to graze sheep and cattle on the unfenced range along the Sierra's flanks.[21] From the mere meeting of local demands production expanded so that now certain of the Mother Lode's crops reach distant markets.

The two most representative and valuable crops are hay and fruit. Hay takes first place in all the counties except El Dorado. The pre-eminent position of hay and forage is related to the demands of the livestock industry and to general lack of irrigation water. A considerable acreage in hay is dry farmed and small areas on the better soils are in irrigated grains. Tuolumne County reports oat hay as its principal field crop with increasing amounts of ladino clover.[22] Hay, barley, wheat and oats lead in Calaveras County's crop returns.

Horticulture as one of the region's oldest branches of husbandry is attested by the many old orchards of fig, olive, almond and hardy fruits seen today along the byways of the Mother Lode. Small acreages are planted to apples, walnuts and chestnuts and vineyards are common, although grapes are not now so widely grown as in former years.

The northernmost county, El Dorado, has emerged as the Mother Lode's principal deciduous fruit-growing district. In crop land acreage, number of farms and crop income, El Dorado heads the list. The value of fruits and nuts was $3,629,000 in 1948,[23] an excellent return considering the elevated and rugged nature of much of the county's surface.

Several factors favor deciduous fruit growing in the piedmont strip. Climate is significant and in turn is related to elevation, slope and land forms. A so-called "thermal belt" extends practically the length of the Sierra Nevada at elevations of 1000 to 3000 feet, and the Mother Lode is a section of this zone. Summer temperatures are high: at Placerville the July average is 72.7°(F.) and at Sonora 75.8°. The summer is long, hot and dry, not unlike that of the adjacent Great Valley. Winter temperatures are moderate: Placerville's January average is 41.2° and Sonora's 43.8°. The average length of the frost-free season for the two stations is 205 and 226 days, respectively--approximately seven months.[24]

But these data do not reveal the piedmont zone's outstanding climatic advantage. The more elevated position relative to the Valley floor insures in the foothills air drainage in winter and greatly diminishes frost hazard. It comes as a surprise to find occasional bearing orange trees in the Mother Lode, until one remembers that citrus fruit is grown commercially as far north as Oroville in Butte County. The fruit-growing belt of the Mother Lode falls between 1000 and 2500 feet in the main. Seventy-six per cent of the pears in El Dorado County are grown between 1500 and 2800 feet. At this elevation the fruit matures slowly and is marketed after the bulk of the Valley crop has been disposed of.

A variety of soil types is utilized in deciduous fruit growing, but the Aiken clay loam of the Placerville district supports a large proportion of the pears grown in that area. This red soil occurs on gently rolling to steep slopes, is well drained and contains a moderate amount of organic matter.[25] Wherever water is available for irrigation these soils and similar ones have been cleared and planted to orchards.

Amount and availability of water supply contribute also to El Dorado's position as leading agricultural county of the Mother Lode. Throughout the region water ditches and flumes were extensively constructed during the early mining period. These conduits tapped perennial sources in the mountains and carried water to mining districts, particularly those employing the hydraulic method.

In El Dorado County alone 247 miles of canals were in operation as early as 1856.[26] Although most of these historic ditches have disappeared, some were kept in repair and are today supplying irrigation water to orchards and gardens. Further to extend the control of water supply and thus the irrigated acreage, the El Dorado Irrigation District was organized in 1926, emcompassing 30,000 acres of land of which 7000 acres were irrigated in 1945.

Pears constitute the most important crop. Of the total acreage in

fruits in 1948, 4056 acres were planted to pears, which yielded 27,000 tons at the last harvest.[27] One half the tonnage was canned and one third shipped fresh to West Coast and eastern markets. Other fruits--apples, plums, cherries and peaches--were produced in small amounts.

Placerville is the center for processing and packing of these high quality products. Cooperative associations operate five packing plants which are linked with Sacramento by rail. Of all the Mother Lode counties, El Dorado's agriculture is best developed, most highly specialized and commercially most profitable. A combination of economic and geographic factors are involved of which favorable climate and adequate water supply are probably most influential.

Other Transit Aspects of the Mother Lode

Obviously recent improvements in communication facilities has enabled the Mother Lode to capitalize on its expanding economy. The narrow pack trails of 1849 widened as movement of freight and miners' supplies increased. Through the years alterations in the quality of highways were made, but the road pattern was little changed. One longitudinal thoroughfare, Highway 49, today connects the major towns that began as camps in 1848 and 1849. It follows essentially the Mother Lode. Crossing this north-south artery at the biggest towns, several transverse highways extend from Valley cities eastward to the negotiable passes of the Sierra Nevada. For example, the main road east of Sacramento goes via Folsom to Placerville, then follows the interfluves between the South Fork of the American River and the Cosumnes to the divide at Echo Summit. This highway carried the heavy stage, freight and mail traffic bound for the Comstock Lode and other Nevada mines in the 'sixties. Today it is second only to the Donner Summit highway in handling traffic directed to the Tahoe region and points farther east. These are high mountain roads; the elevation of Donner and Echo summits exceeds 7000 feet. The pass crossing of other roads to the south increases gradually to the 10,000-foot climax at Tioga.

All these passes easterly of the Mother Lode are winter-closed, for here about the Sierra's heaviest snowfall is recorded. Tioga is usually impassable for nine months while Sonora, Ebbetts and Kit Carson, though more northerly, are somewhat lower and are obstructed for shorter periods of time. The Tioga road does not function as a commercial thoroughfare owing to seasonal closure and location through a purely recreational area. The other transverse roads carry a moderate traffic in the lower inhabited elevations where scattered industries are centered. And minor roads diverge from the major highways to serve isolated districts above and below the Mother Lode.

The "cow path" origin of highways is apparent in the narrow and sinuous main street of the towns, and this feature of "horse-and-buggy days" creates today a serious traffic problem. Jackson has broken with the past in cutting a new highway which by-passes the congested part of town. But Placerville and Sonora would find such a shift impossible because they already occupy completely the valley bottom and enclosing slopes.

Short branch railroads from Valley towns enter the Mother Lode country to serve particular needs. The most important is the branch of the Southern Pacific east of Scramento which serves lumbering and fruit-growing interests at Placerville, Camino and Diamond Springs. The

Sierra Railway penetrates the region at several points serving the lumber industries at Standard and Tuolumne east of Sonora, and mining activities farther north. Some lumber companies operate narrow gauge railroads to logging camps above the industrial zone. Mariposa County is now without a railroad. The Yosemite Valley line which formerly operated between Merced and El Portal was removed during the recent war.

In no other feature is the transit nature of the Mother Lode better revealed than in the transfer of water and power. Obviously the two forms are related. The dam and reservoir, penstock and power transmission line are prominent features of the foothill landscape. The five major rivers that transect the Lode perform multiple functions. Tuolumne and Mokelumne supply municipal water to the big cities around San Francisco Bay. The water from all five streams supports many irrigation districts in the foothills and valley. Hydroelectric power is generated along the river courses by municipality, irrigation district and public utility corporation. Thus, two power plants on the South Fork of the American River, six on the Mokelumne, five on the Stanislaus, three on the Tuolumne and two on the Merced generate in the vicinity of the Mother Lode region a combined total of 600,000 horsepower of energy.[28] Most of this power is distributed to Valley and coastal communities over Pacific Gas and Electric Corporation lines. The same company supplies electricity as well as domestic water to several Mother Lode communities.

POPULATION

The population of the Mother Lode counties has fluctuated during the century of occupance. There were 70,000 persons living in these counties in 1860, the year when Los Angeles had only 9300 inhabitants, exclusive of Indians. From that time on population decreased. In 1920 it dipped to its lowest point when only 31,000 inhabitants were reported. Since that year there has been an upswing. In 1940 47,000 persons resided in the Mother Lode counties,[29] and recent estimates indicate continuing increments which may give a total population of 50,000 in 1950.[30] For the first time since the palmy years of early mining, the number of inhabitants is approaching that of the late 'fifties and early 'sixties. El Dorado County's estimate for the year 1949 duplicates the number of residents of 1850. It is the Lode's most populous county, although not the largest in area, a leadership supported by diverse and stable industries.

The metalliferous Lode determines the location of the population. Generally speaking, population is dispersed in a narrow north-south belt, the zone of the placer deposits and deep gold-bearing veins. But tiny isolated groups of people and elongated extensions occur here and there in the narrow valleys adjacent to the main mineral belt. Some of these little centers are maintaining their place in the regional economy. Such are Tuolumne City and Soulsbyville near Sonora, centers of lumbering and orcharding.

The largest agglomerations are the cross-roads communities where east-west routes between Great Valley and the Sierra intersect Highway 49. These towns, moreover, are centers of industry and are the market towns for the population that is predominantly rural. The small unincorporated place is the rule along the Mother Lode. Of the eight incorporated communities, only five have a population greater than 1000 persons. Placerville is the largest town of the entire Mother Lode country with 4000 residents, while Sonora has 3000 and Jackson only 2500.

The population is overwhelmingly native white. A noticeable excess of men exists, suggesting a persistence of frontier conditions and preponderance of extractive industries. Increasing amenities, however, are evident in the large communities as contacts widen and pioneer features weaken.

The area is probably as active and prosperous today as at any time since the first flush of gold mining. Exhaustion of the easily recoverable metal induced a slow decline and saw Mother Lode economy deteriorate almost to the vanishing point. But intermediate position between regions strongly complementary saved it from oblivion. Reciprocal activities between Sierra and Great Valley are redounding to the revival of Mother Lode business and industry. The economy, adjusting to an entirely new set of conditions, seems to be entering a new phase of development better balanced and more stable than the old.

This is not to say that the Mother Lode country will ever occupy a major place in the affairs of the State. But we should not forget that already it has played a noteworthy role in the annals of California. Here occurred the first transplantation in the State of American culture. Economic and social experiments were made and the knowledge acquired became the basis of the progress that marked the later expansion of California as it moved into ever larger spheres of activity. Methods employed in the gold mining camps were adopted all over the world; food demands stimulated agriculture, today the outstanding California industry. The rapid increase in West Coast population provided an incentive to railroad construction "...that opened the way to the full exploitation of the west by all forms of American enterprise."[31] If it be true that "gold is the cornerstone" of present-day California, then the block is set in the area of early mining along the foothills of the western Sierra Nevada.

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SUSTAINED YIELD FORESTRY IN THE PUYALLUP VALLEY, WASHINGTON

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Much of the controversy concerning the best use of natural resources stems from lack of knowledge. This is particularly so in respect to sustained yield forestry. I will never forget the open-mouthed wonder with which one older woman received the information that trees mature and grow old. To her the older and bigger the tree, the stronger the argument against cutting it down. Her attitude reflects the cursory or non-existent knowledge of the general public about the newer methods and objectives of both the forest service and the private logging companies. This discussion of the current and planned activities of the St. Paul and Tacoma Lumber Company will clarify some of the trends in modern forest management in the Pacific Northwest.

Tree farms are privately owned forests under special standards of management for timber growing. Owners who apply for certification agree to inspection by professional foresters and also to:

1. Maintain a specified area for growing tree crops,
2. Provide protection from fire, insects, disease and destructive grazing,
3. Conduct timber harvesting on a plan to assure reforestation,
4. Supply information to certifying agencies.

In western Washington and Oregon there are at present nearly 2,750,000 acres of tree farms under private forest management. Tree farms are also found in seventeen other states and total some 15,000,000 acres.

Approximately eighty percent of the St. Paul and Tacoma Lumber Company holdings lie in the upper Puyallup and Carbon River valleys in southern Washington, the balance being in the White River district a little farther north. At present logging of virgin timber is carried on within sight of the western border of Mount Ranier National Park. The forest acreage covers the whole glaciated upland between the Puyallup and Carbon Rivers, and extends southeast of the Puyallup. Within this area lie virgin timber stands, recently cut-over lands, some 10,000 acres of burn, and land covered by second growth forest varying in age from ten to fifty years. The whole unit is being managed as a tree farm totalling just under 200,000 acres. Approximately 135,000 acres are owned by the St. Paul and Tacoma Lumber Company, and some half dozen smaller owners also are involved in this cooperative venture.

Whenever possible the company maintains a small reclaiming mill near the scene of current logging activities, to make possible the utilization of much timber which otherwise would have to be abandoned because of the high cost of transport to the main Tacoma mill. Forest areas to be cut are pre-logged to take out small trees in the way of logging operations. After the main operations have been completed, post-logging is carried on to clean out any merchantable timber left on the ground. An attempt is made to use caterpillar tractors whenever feasible, because they make possible the removal of logs without destroying much timber. The high-line, so destructive of timber and small growth, is used only in the most rugged areas.

During the war the average yearly cut of the company was 4500 acres, but for the last two years it has declined to 3000 acres. Most of the timber is taken by rail and truck to the main mill at Tacoma, although some surplus has been available for sale to other companies. It is estimated that between fifteen and eighteen years of continuous operation at current rates will see the end of virgin timber supplies in this area. By that time, however, second growth now in the forty to fifty year age group should be available for cutting. This volume, supplemented by timber which may be purchased from the national forest should, in the opinion of the company forester, allow the permanent maintenance of all age groups through seventy within about thirty years of the present date.

The clear cut, seed block system of logging is being used in an attempt to reseed cut-over lands within five years.[1] Selecting the location of seed blocks still is an only partially solved problem. Clear cutting in contrast to selective logging results in even age stands of second growth and has been found most practical for the Douglas fir area because of the denseness of stand, the ruggedness of topography and, most important, the lack of shade-tolerance on the part of seedlings. Douglas fir normally bears a good crop of seed every three years, with a heavy crop every seventh. If reseeding has not been accomplished within five to seven years the company resorts to artificial planting, at a cost of approximately $18.00 per acre.[2] It is an interesting fact, which should be emphasized, that once second growth is established each acre will produce more board feet of timber than was ever the case for the mature virgin forest. Six to seven hundred board feet per acre is the average for the best unthinned second growth. Once reseeding is accomplished, protection against fire and disease become the most important activity of the company.

A seventy-year cycle is the basis upon which all plans for this area are being made. Although government foresters and a few of the largest timber companies have used a ninety to one hundred year cycle, taxes have forced smaller companies to rely on the shorter period. Growth of Douglas fir to merchantable size requires from sixty to seventy years on the best sites. The best cycle, therefore, requires that the company obtain enough acreage that the annual cut may amount to no more than one-seventieth the total. In such case all but a fraction of the land would be continuously growing timber.

In order to reduce fire hazard every attempt is made to clean up after primary logging is completed. Slash burning, required by the state, is dangerous. This is evidenced by an area of over 10,000 acres burned in

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1. Clear cut and seed block as terms refer to the complete removal of all growing timber except for certain blocks of trees left to serve as natural sources of seed for new growth on cut-over lands.

2. The Weyerhauser Timber Company in February, 1949, and the Crown Zellerbach Corporation in 1948, used helicopters for tree seeding operations. The plane flies at 60 miles per hour at an altitude of 50 feet, using 150 pounds of seed per square mile, giving an average seeding of one-quarter pound per acre. Weather conditions are of primary importance. Calm dry weather is essential, so that seeds do not blow and that they do not stick to wet vegetative surfaces. Mechanical planters are not feasible to date because of the difficulty of packing seedlings and owing to the ruggedness of the terrain.

1942 when a slash-removal fire got out of control of the crew. The area had reseeded very nicely and second growth already was well established at the time of the fire. For this reason many foresters feel that with careful pre-logging, post-logging and the removal of snags, slash burning might be eliminated except in extreme cases. They point to the fact that most hemlock slash rots on the ground in two years and that of Douglas fir within fifteen to twenty years.

Organization for fire prevention requires the most careful planning and is a heavy and constant expense. It is, however, well worth the fullest attention that can be given it, since it is the source of major damage to both old and young forest growth. The first fire organization was a cooperative association which was financed through assessments made on member companies. These funds were used for patrols, lookouts and equipment. Companies now, however, pay assessments and fees directly to the state which has taken over control of this protection. All logging companies are required to have fire fighting crews on the job at all times, and tank trucks and pumps are located at each camp. The federal Forest Service maintains its own equipment and patrols but cooperates with the state agencies and with private concerns.

Every company concerned with sustained yield forestry finds the tax situation a major factor in working out their plans. In one sense the county and state make owning this forest land a risk and only cooperative action against the tax problem is effective. A county cruise made in 1929 is the base for assessment. Stumpage value is assigned each species of tree according to altitude. Appeal may be made to an equalization board by a company. Each year a report is made of the amount of logging and the assessment drops. A land tax must be paid on the total acreage, but special rates of $1.00 per acre are now possible on reforested areas. This rate, however, requires that a 12-1/2% yield tax be paid to the state at the time of harvesting timber.

One of the most interesting phases of the St. Paul and Tacoma Lumber Company tree farm is the Voigt Creek Experimental Area lying in the northern part of the main company holdings. Here experiments in commercial thinning operations are being carried on. Within this unit of 240 acres are three compartments which, with the cooperation of the United States Forest Range and Experiment Station at Olympia, are being thinned according to undesirable species, deformed trees and competition because of crowding. The stand is thirty-six years old, was logged off in 1901, burned over and finally reseeded. Each of the three compartments is being thinned differently, one approximately 20%, another about 30% and the third about 40% by volume. The cost of heavy thinning is about $350 per acre, and such work is planned possibly twice before maturity of the forest stand. All work is done with horses and nothing is left on the ground over three inches in diameter. Cedar logs left lying on the ground during the original logging operation, and larger snags, are split into seven foot lengths for fence posts, and all windfalls are removed. The marketing of these thinnings has so far been successful but it constitutes the major problem in financing the operation. Most of the volume is taken by the Tacoma smelter. The tops of trees are used for twelve foot car stakes, but no tops have so far been sold for pulp. The plans for the next thinning five to ten years hence call for pulp wood or small saw logs. It is hoped that thinning operations on similar stands will be facilitated by the sale of most of the volume to the St. Regis Paper and Pulp Company of Tacoma.

Thinning operations have been carried on in the Voigt Creek Experimental Area for two years with a crew of fourteen men and have proven a good commercial venture. Whereas the best unthinned sites produce between 400 and 700 board feet per acre, experience in this trial area suggests that thinned stands will produce up to 1000 to 1200 board feet per acre. Similar work being carried on by other companies, particularly Weyerhauser, will give much additional information to the forest experiment station at Olympia.

Though much progress toward sustained yield forestry has been made in the Douglas fir region, all problems have not been solved and much more experience is necessary to attain complete success. Some of the problems include:

1. Selection of the best sites for seed blocks and seed trees. Wind throw and uncertainty of eddy currents in the distribution of seed cause difficulties in establishing re-seeding on cut-over areas by natural means.
2. Satisfactory disposal of slash, most of which at present cannot be marketed in any form. The hazards of burning are by no means solved.
3. Taxation. The tax base varies from county to county. The tax problem affects decisions as to the length of cycle that shall be used in logging operations, and can make necessary the cutting of timber before it has attained the most marketable size.
4. Fire protection costs. Fire protection still constitutes the heaviest single expense, and this outlay can be nullified by the carelessness of just one person.
5. The financing of commercial thinning operations through the sale of thinnings. Thinning is now proven to the point that it would be much more widely adopted if markets could be found for the products.
6. The accumulation within fairly continuous blocks of land sufficient in total area to produce timber adequate to company needs.

The primary purpose of establishing tree farms is to insure a permanent future supply of wood for all of its 4000 or more uses. A closely related purpose is to give continuity to the economic operations of lumber corporations and the population dependent upon them. Presently operating tree farms are experimental plots, and their management will help to supply solutions to many forest problems. If and when these problems can be solved it is probable that even more activity in second growth forests will be carried on in the Pacific Northwest. Not only will there be a simple increase in the area of such forestry, but there will be more frequent thinning and delimbing operations in order to stimulate the growth of clean timber for the production of clear lumber. The St. Paul and Tacoma Lumber Company tree farm is only one of a number now operating but it is representative of the intelligent planning for the conservation of one of our most important renewable natural resources.

THE DEVELOPMENT OF THE PORT OF PRINCE RUPERT, BRITISH COLUMBIA

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Prince Rupert was founded in 1909 to serve as the Pacific coast terminal of the Grand Trunk Pacific Railway, now a part of the Canadian National Railway System. It was chosen because it possessed an excellent land-locked harbour, ease of access and was free from dangerous currents. The builders of the Grand Trunk Pacific conceived of Prince Rupert as a world port. Owing to the westward swing of the northern coast Prince Rupert is located 500 miles closer to the Orient than any other Pacific terminal. It was thought, therefore, that the vast potential trade between Asia and North America would pass largely through the port of Prince Rupert. In order to assist this potential trade, the railway builders planned that the roadbed through the Cordillera should have the lowest gradient on the continent, in order that operating expenses could be cut to a minimum. This object could not be completely achieved and one other railroad, the Canadian Northern, which now forms the Canadian National's southern line to Vancouver, was able to cut its maximum gradients below those of the Grand Trunk Pacific. To achieve this first class roadbed, the Grand Trunk Pacific went to great expense. Between Terrace and Prince Rupert, a distance of some 90 miles, the Skeena River runs through a fiord-like valley with the mountains of the Coast Range rising abruptly above the river bank. To bring the road to grade in this section entailed the movement of over 8 million tons of rock at a cost of $80,000 per mile.

In Prince Rupert itself much the same difficulties were encountered. Here the land rises abruptly from the sea to a height of from 50 to 100 feet. To construct railway yards and docks required the blasting of a shelf out of the solid rock. The abrupt rise of the land is matched by the abrupt drop of the coast. It was found impossible to construct piers of the ordinary type and steamship wharves were built parallel to the shore. Pilings up to 110 feet long had to be employed on the seaward side of the wharves though they were only some 50 feet from the shore.

The city itself was planned for a minimum of 30,000 people. Extensive areas along the waterfront were zoned for industrial and commercial use. A large drydock and a shipyard were constructed, the former capable of handling ships of 25,000 tons. A grain elevator of 1,200,000 bushels capacity was erected along with extensive wharves and warehouses to handle the expected trade of the Orient.

The two streets which were to contain the commercial core were made 94 and 72 feet wide respectively. The first class residential areas were planned with broad contoured streets and generous lots. Unfortunately the other residential districts were allowed only 25-foot lots.

The city was not, however, able to fulfill its planned function. It became what may be termed a "misfit city." It was planned as a potential world port, but it became a frontier port. The reasons for this disappointment were many. The railway was not completed until 1914. This date marks the end of the large-scale movement of immigrants into Canada. They had provided the impetus for the westward and northward movement of the frontier during the previous decade. The Grand Trunk Pacific was

essentially a pioneer line trending westward across the northern prairies and British Columbia. With the halt of migration, settlement of the northern line stopped and a period of consolidation began. The resources of the northern line were not fully utilized because they required a greater expenditure of energy, time and money in their extraction, transportation and utilization than did the resources of the more southerly sections. Prince Rupert felt this acutely because of her peculiar relationship to her hinterland. Prince Rupert is set on the western margin of the Coast Batholith which rises abruptly from the water's edge to rounded peaks of 3000 to 5000 feet. The Skeena River cuts through this range without changing its characteristics, and the steep slopes of the mountains extend right to the river bank. It is necessary therefore to travel more than 90 miles up the river before land capable of cultivation can be found.

Rather than patronizing this hinterland the merchants of Prince Rupert found it more convenient to purchase their supplies from Vancouver with the attendant advantages of greater selection and earlier appearance of fresh vegetables on the market. Approximately 80% of Prince Rupert's food supply is shipped north by boat from Vancouver which has a more temperate climate. This means, of course, that money spent on the Prince Rupert food market is permanently lost to the city. Instead of going to the farmer of the hinterland who will eventually spend it on goods and services in Prince Rupert it goes to the Fraser Valley farmer who spends it for goods and services in Vancouver. The lack of agricultural development in a nearby hinterland in turn provides only a small selection of cargoes to be handled by the port.

The expected Oriental trade failed to materialize. The grain elevator opened in 1924 and the next year 22 ships loaded with grain for the Far East, largely to Japan. The next year nine loaded, the next one. Within a few years the grain trade to the Orient ceased. Prince Rupert could not offer a variety of produce due to the lack of development of her hinterland, and during normal times west coast shippers rarely dispatch shipload lots of a single cargo such as grain.

The poverty of the Orient was also a factor. Shipping figures suggest that the total oriental trade with North America would only be sufficient to support one large-scale port, let alone the five that were competing for this trade. The majority of the Pacific Coast trade was, and still is, with Europe via the Panama or Suez and in such a trade pattern Prince Rupert is completely out of the picture.

These factors radically altered the role for which Prince Rupert was created and there concomitantly came a change in the city's functional pattern. The large-scale port facilities stood idle, the grain elevator and the warehouses were empty. The small boat facilities were, however, extremely well used. The halibut banks of the North Pacific stand at Prince Rupert's doorstep and the railroad facilities made transit of fish to the eastern market easy and efficient. Prince Rupert became a fishing port. Three large cold storage plants were established, the largest capable of holding 14 million pounds of frozen fish. The drydock designed to accommodate deep-sea liners was utilized to repair and overhaul fishboats.

The town designed to accommodate a minimum of 30,000 people had to adjust itself to a maximum of 7000. Because of early expectations the whole of the town was thrown open for sale and people built their houses in a scattered pattern. It was hoped that the empty lots would soon be occupied

as the city developed. The development never materialized and the city found itself faced with the maintenance of over-extended roads, sewers, waterpipes and other services with only a few tax-paying residents.

In addition there were the problems attendant upon the nature of the site. Prince Rupert is built either on rock or muskeg. The city rises abruptly from the sea in three levels, to a ridge of 200 feet about 1/4 of a mile from the shore. The first level is largely artificial, contrived by blasting, and contains the railway yards and port facilities. The second level contains the two streets of the commercial core and is backed by an abrupt rise to the third level which comprises the first class residential area. Beyond this ridge the land dips gently into a basin some 75 feet lower than the seaward ridge. This basin extends to the foot of the mountains which rise about two miles back from the shore. There is no uniform pattern to the occurrence of rock and muskeg but generally the three levels are of solid rock while the area back of the ridge is muskeg. Both rock and muskeg are extremely expensive and difficult on which to build. In the rock, sewers, watermains and roads must be blasted down to grade. In the muskeg, cradling and large amounts of fill are necessary to produce firm foundations. This combination of difficult terrain and scattered population proved too great a burden and Prince Rupert went into receivership in 1931. The city's debts were assumed by the Provincial Government which also appointed a Commissioner to administer the port city. Prince Rupert's fortunes sank to their lowest ebb. The spirit of optimism and expansion associated with the frontier disappeared. Prince Rupert remained a frontier port, but on a stagnant frontier.

The coming of World War II brought many changes. The shipyard began construction of Liberty ships and minesweepers. The entry of Japan into the war brought threats of aggression to Alaska, and her defenses had to be greatly augmented at a time when shipping was at a premium. By utilizing Prince Rupert 500 miles of water transport were eliminated. It was also possible to use barges to carry supplies up the landlocked Inside Passage as far as Skagway where they could be moved by railway to Whitehorse and the Alaska Highway. All of the port facilities were turned to use and new warehouses were constructed giving the port a potential of at least 50,000 cubic tons of freight per month. In all one and a half million tons of freight and 73,000 men moved through Prince Rupert during the course of the war.[2]

The post-war legacy of wartime expansion was twofold. First were the material additions to the port. Part of these, at Port Edward, ten miles from Prince Rupert, are being utilized by the Celanese Corporation of America for the establishment of a high alpha pulp plant costing some 30 million dollars. On completion the plant will turn out 250 tons of high alpha pulp per day. The plant is under construction and should be completed by 1952. The first permanent, year-round industry on a large scale will do much to stabilize commerce.

The second legacy may ultimately be more important. It is the realization that Prince Rupert is the logical port to service Alaska. Goods from the industrial east and American mid-west can be moved by rail to Prince Rupert for exactly the same cost as to Seattle. But Prince Rupert is some 500 miles closer to Alaska than Seattle and water shipping rates are in consequence much lower. At present, utilization of this cheaper transport route by Canadian vessels is prohibited by the Jones Act and the American lines based in Seattle have shown little interest in using the port.

This is one of the reasons for Alaska's cry for statehood for, when territorial status is left behind, the Jones Act becomes inoperative and Canadian shipping will be able to carry from Prince Rupert with the resultant lowering of transportation costs. At the present time the Jones Act has been modified, and for a period of two years Canadian shipping will be allowed to service Alaskan ports. This is too short a period to allow any substantial development, though traffic movement through Prince Rupert has been considerable since the modification of the act.

There is, however, another major obstacle which Prince Rupert must overcome before she can become a service port for Alaska. Seventy per cent of the cargo moving to Alaska is fresh foodstuffs and groceries which originates largely near Seattle. To compete successfully Prince Rupert would have to be able to supply these goods as cheaply as does Seattle. At present this is impossible because Prince Rupert imports the majority of her own goods from Vancouver.

If, however, the increasing industrial growth of Prince Rupert were to stimulate a reciprocal growth in her agricultural hinterland this condition could be met. Eastward from Terrace, and bordering the railway line, are some 900,000 acres of agricultural land capable of growing temperate crops now lying unutilized owing to the lack of a market.[3] An interesting development took place during the summer of 1949 which is symptomatic of the acute maladjustment of transportation to Alaska. Weekly shipments of fresh foodstuffs and groceries originating in Seattle were transported by rail to Prince Rupert, a distance of 1112 miles compared with a water haul of 572 miles, and were then shipped by barge to Haines and the Alaska Highway. Even with this roundabout route it was possible to reduce costs sufficiently to justify continuation of this method during the coming summer seasons.

Prince Rupert has been forced to come to terms with its environment. The original over-estimation of the potentialities of the location led to over-extension of large-scale port facilities and city area. With a realization of the actualities of the environment came a change in role and function, a change from world port to fishing port; from transcontinental terminus to "end of rail." At present another period of expansion is taking place, this time on firmer foundations and in fuller realization of environmental possibilities. The forest resources of the hinterland are being utilized in the cellulose plant at Port Edward. The factor of position and the small, but important agricultural hinterland will be increasingly utilized as trade with Alaska develops. If surveys are successful, the next decade will see the development of an aluminium industry tributary to the northern line of the Canadian National Railway which will utilize over one million horsepower of the hydroelectric resources of the Coast Range. These diversified developments signify a healthy, gradual expansion to which Prince Rupert can adjust with ease.

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REGIONAL INFLUENCES UPON THE CANADIAN RAILWAY PATTERN

Willert Rhynsburger

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All geographers recognize that regions are dynamic and functioning rather than static. However, practising geographers have not yet taken up the systematic analysis of regional dynamics, of regional circulation, although in studies of regional economic geography many generalities are expressed. Analytic studies of the movement of commodities and of persons remain the concern of commercial rather than of academic pursuit, principally because of the stupendous mass of statistics involved, and especially because the data lie deep within the archives of business institutions themselves.

Thus, students of the geography of movement have been obliged to content themselves with observing map patterns of transport routes, occasionally given third dimension by means of the insertion of values for traffic flow. However, routes do not make a transport region. In a sense they are neuter gender, for the essence of regional circulation is to be found in the shipping and receiving of goods rather than in the process of their transport. Only where they influence the location of terminals do routes have regional significance, and in this case the influence is primarily chronological rather than chorological. Proper study of regional circulation starts with the region, and concerns itself first with the objects moved, secondarily with the places of departure and arrival--the terminal--and only thirdly with the modes of movement. Although the following observations do violence to this set of rules, they are presented as a preliminary statement concerning aspects of transportation geography applied to Canada.

In contrast to their position in the United States, the railways of Canada are of pre-eminent significance to the national economy, a status which the marvelous Great Lakes waterway modifies only in part. The patterns of railway routes throughout the settled portion of Canada will be considered briefly with reference to the accordance between these patterns and the major physiographic realms.[2] From such consideration, some ideas affecting regional circulation may be drawn.

The physiographic divisions are the Cordillera, the Prairies, the Canadian Shield, the St. Lawrence Lowland, and the Maritime Provinces. All these differ from one another in important physicial and cultural features and, from the point of view of gross railway patterns, differ vastly in area and in density of rail network (Table I).

TABLE I. CANADIAN RAILWAY MILEAGE BY PHYSIOGRAPHIC DIVISIONS[3]

Region	Area (sq. miles)	Railway mileage	Length of line per 100 sq. miles
St. Lawrence Lowland	61,000	9,060	14.8
Maritime Provinces	65,000	4,120	6.3
Cordillera	160,000	3,754	2.5
Shield	217,000	6,170	2.8
Prairies	225,000	17,503	7.7

The areas indicated refer to the portions of the respective physiographic realms which lie within effective railway influence, i.e., within 30 to 50 miles of the lines. This accounts for the omission of the CNR Prince Rupert line, the Northern Alberta railways, the Hudson Bay Railway, and the Ontario Northland, to James Bay.

THE CORDILLERA

The Cordilleran region shares with the Shield the position of having the scantiest rail coverage of any of the regions, with only 2.5 miles of line per 100 square miles of area (Fig. 1). These lines are from 50 to 100 miles apart. The region has a high proportion of main line to branch line mileage, testifying to the transit nature of rail service in this thinly settled region. The map pattern reveals the strong influence of river valleys, which was once noted also by Griffith Taylor, who remarked that, unfortunately, the "grain of the country" runs counter to the regional flow of traffic.[4] This produces a marked angularity of rail pattern which is not characteristic of other Canadian regions except the Maritimes, and makes for great disparity between surface and air distances from point to point. The four lines radiating from Vancouver form the rather deranged ribs of a fan, spreading out northeastward toward various Rocky Mountain passes.

THE PRAIRIES

This tremendous region (Fig. 2) is outstanding in that it contains more than 17,500 miles of line, fully two fifths of the total Canadian mileage, yet despite its great areal extent the region ranks second to the St. Lawrence Lowland in density of rail network (a poor second, however, with 7.7 miles per 100 square miles of area, about half the figure for the Lowland). Except for the Soo Line connection at Portal, North Dakota (CPR-controlled), no corporate rail lines cross the international boundary between the Rockies and the Red River, which means that the enormous agricultural production of the Prairies is largely funneled eastward, through Emerson and, overwhelmingly, through Winnipeg. Because of this, there is a high degree of parallelism of lines, with a northwest-southeast trend, and relatively few transverse lines. The density of rail coverage is also very uniform, with lines that are between 20 to 40 miles apart, though lighter in Palliser's Triangle, for efficient movement of the bulk grain traffic.[5] In contrast to the Cordillera, the Prairies have a high proportion of branch lines to main lines, which suggests that here the drawing-off of surplus is more significant than the pure transit function. The railway alignment shows comparatively small regard for rivers, and it is less in valley routeways than in the placing of economical river crossings that rivers have influenced rail location. Transport foci of considerable local importance are discernible in the pattern, but these are subservient to Winnipeg and tend to be obscured by the over-all density of lines.

THE SHIELD

The area of the Shield, 217,000 square miles as accounted here, is slightly less than that of the Prairie region (Fig. 3). This is because the zone of railway influence narrows toward the west. For example, where the CNR passes north of Lake Nipigon it is less than 90 miles distant from Lake Superior. The railways on the Shield are widely-spaced, however, lying from 35 to 125 miles apart. Closer spacing is confined to the southeast. The strong linear pattern with east-west orientation indicates prop-

erly the transit function of the Shield railways, whereas the bundling of these transit routes at Thunder Bay and in the Sudbury district shows the influence of terminating and originating tonnages respectively. The two long north-south lines are essentially extended branch lines. The Ontario Northland is a provincial line built to open up new agricultural zones, particularly in the Clay Belt, but which incidentally came upon the important metalliferous areas. The Algoma Central and Hudson Bay Railway, in reverse, was built for the purpose of bringing out iron ore and other mine products, and was later extended to the Northern Transcontinental in the western part of the Clay Belt. Short branches south of the Ottawa River are old agricultural development lines into the Ottawa-Huron Tract.

ST. LAWRENCE LOWLAND

This, the smallest in area, is the metropolitan region in all respects, and it has the closest railway net, with lines between 5 and 25 miles apart and an average of 14.8 miles of line per 100 square miles (Fig. 4). Branch lines predominate, but together with many important main lines, these produce an extraordinary number of intersections, and therefore a pattern which is indicative of a high development of regional production and interchange. The several great transport foci: Windsor, Niagara Falls, Hamilton, Toronto, Ottawa, Montreal, and Quebec, are all but lost in the dense coverage of lines, although the greater intensity of development in peninsular Ontario and on the Monteregian Plain is marked. The Lowland is not primarily a transit region, but a place of traffic origination and termination, including port terminals; that is, it is a zone of concentrated production and marketing.

THE MARITIME PROVINCES

In the Maritimes there is much control of rail pattern by local physiographic elements (Fig. 5). Most inland lines follow river valleys, whereas others cling to the coasts. The high proportion of branch line to main line mileage is surprising, since this element indicates regional productivity. However, it must be recalled that this section was the scene of much of Canada's pioneer railway building activity, when short lines were the rule, and that there has been very little railway abandonment. On the rail map of the Maritimes there occurs no such evident focus of routes as appeared in Vancouver or Winnipeg, although the poor showing of Halifax in this respect is due in part to its peninsular location, with its focal function being shared by St. John, the CPR in-port, and by Moncton. The density of rail line, 6.3 miles per 100 square miles of area, is similar to that of the Prairies, but aside from this, the rail features of the Maritimes are most like those of the Cordilleran region, on the opposite coast. These two regions, in fact, rank lowest in total rail mileage, although neither is as small as the Lowland in areal extent.

This brief glance at the rail transport equipment of Canada in its regional settings suggests a broad, threefold classification of regional circulatory functions:

1. The drawing off of the commodities of primary surplus production, or the productive function;
2. The carriage of goods over long distances of unproductive territory, or the transit function;
3. The assembling and interchange of goods at the great manufacturing and marketing centers, or the terminal function.

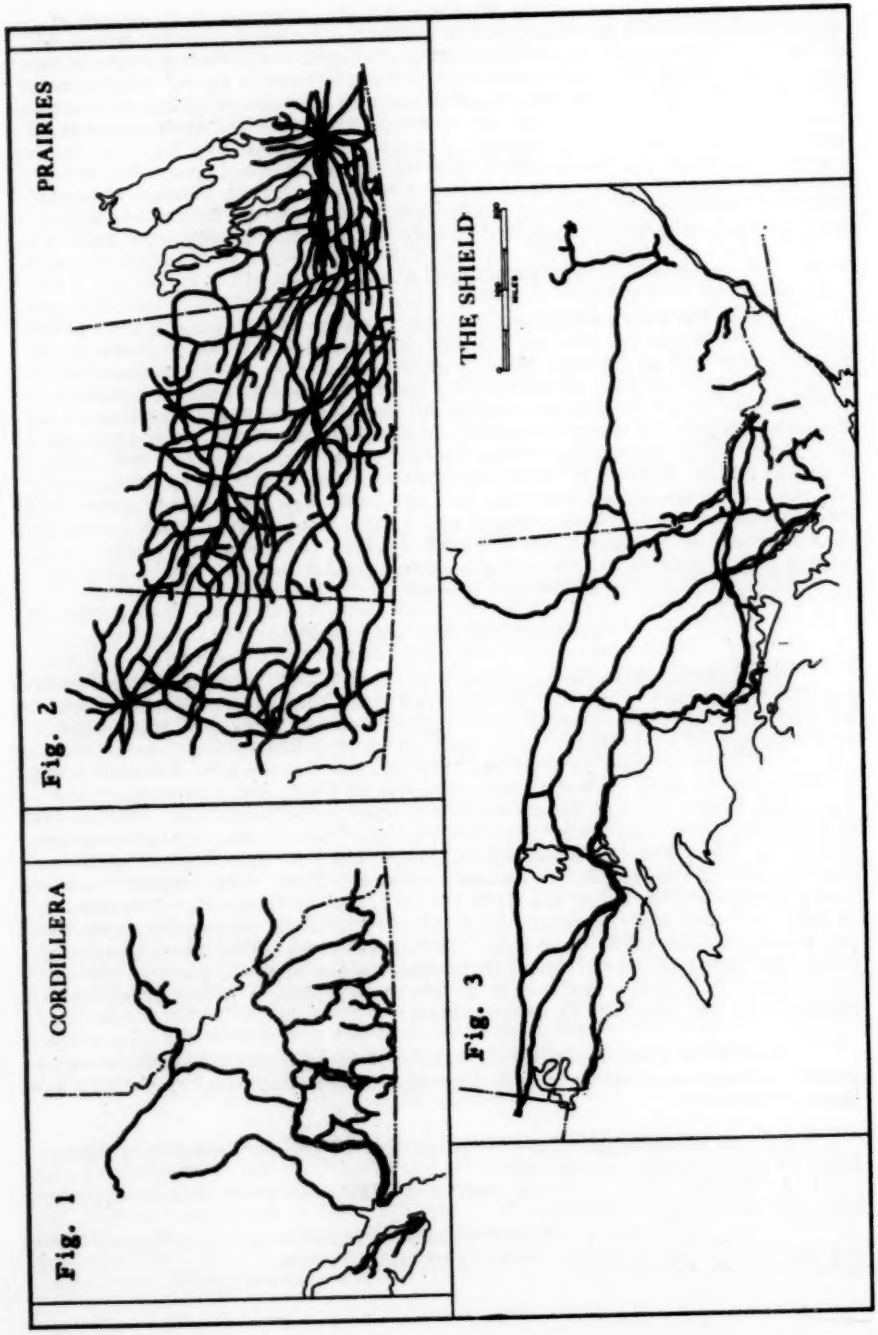

PRAIRIES
Fig. 2
CORDILLERA
Fig. 1
THE SHIELD
Fig. 3

Fig. 4 ST. LAWRENCE LOWLAND

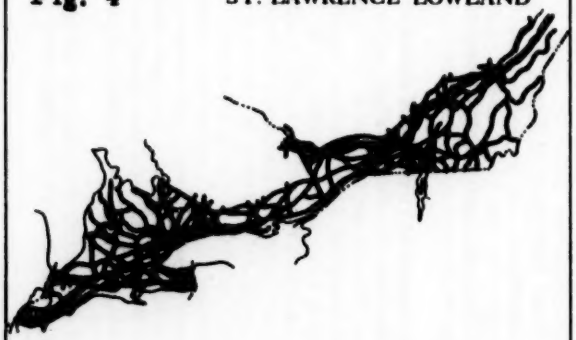
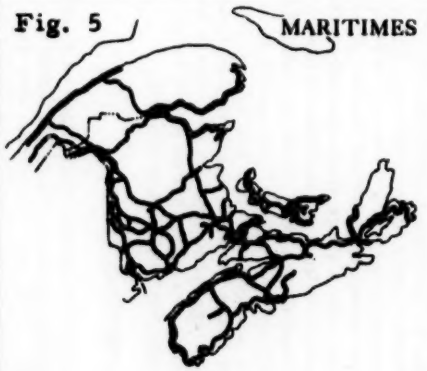


Fig. 5 MARITIMES



CANADIAN RAILWAY PATTERNS

Scale of all maps: 1" = 210 miles

Fig. 1	The Cordillera	2.5	miles of line per 100 sq. mi.
Fig. 2	The Prairies	7.7	" " " " " " "
Fig. 3	The Shield	2.8	" " " " " " "
Fig. 4	St. Lawrence Lowland	14.8	" " " " " " "
Fig. 5	The Maritimes	6.3	" " " " " " "

To use examples from the United States, the rail net associated with the productive function would be like that of the Corn Belt, with its uniform density of rail lines in a pattern of small triangles, with myriads of intersections and frequent stations. The Great Basin, between the Sierras and the Rockies, affords the best example of the transit function, where the region is indeed a negative factor, since it fails to originate enough traffic to warrant the presence of first-class transport routes. The terminal zones are exemplified by the Middle Atlantic seaboard region, between Boston and Baltimore. Upon such a region many lines converge and the density of lines is very great. The congestion of main lines is increased at intervals by the vast areas of terminal yards sited at strategic junctions, manufactural centers, and ports.

Although in reality all gradations of these three areal functions exist from place to place, each of the great physiographic realms of Canada has certain distinguishing transportational characteristics which are identifiable with the map patterns of their railway networks.

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4. Griffith Taylor, "British Columbia: A Study in Topographic Control," Geographical Review, XXXII, 1942, p. 372.

5. "Palliser's Triangle is essentially the semiarid portions of southwestern Saskatchewan and southeastern Alberta. See Currie, op. cit., p. 181.

THE ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

Twelfth Annual Meeting, Vancouver, British Columbia, June 16-18, 1949

The twelfth annual meeting of the Association was held at the University of British Columbia, Vancouver, in conjunction with the annual meeting of the Pacific Division, American Association for the Advancement of Science. Four half-day sessions were devoted to the presentation of papers, the meetings being held in the quarters of the Department of Geography. A short business meeting was held on the 17th of June at the close of the morning session. The retiring president delivered her address at the annual dinner held at the faculty club on the evening of June 16. A field excursion in and about Vancouver occupied the morning of June 18.

Program, and Abstracts of Papers Presented

(Papers published in full in this issue are not abstracted here)

THURSDAY MORNING SESSION, JUNE 16

Port Arthur-Fort William, The Canadian Lakehead. STANLEY A. ARBINGAST, University of Washington.

Abstract. Port Arthur and Fort William, Ontario, share the same excellent natural harbor, located near the western extremity of Lake Superior's Canadian Shore.

These two cities are primarily engaged in the funnelling and transport of bulk commodities, but today both are fulfilling an increasingly important manufacturing function. A trade hinterland having but few inhabitants does not encourage lakehead industry to produce for the local market, so that local materials are fabricated into products for nation-wide distribution.

New industry has been induced to come to the lakehead by abundant cheap power, by an almost unlimited pure water supply, by cheap water transportation, by main line rail service of the two Canadian transcontinental systems, by a stable, adaptable labor supply and by low cost factory sites.

At the close of 1948 industries of the two cities numbered 85; of these 44 were in Fort William and 41 were in Port Arthur. Gross production amounted to more than 80 million dollars; 24 million dollars were paid out in wages and some 12 thousand men and women were employed.

In an average year over a quarter million bushels of grain are shipped to domestic and foreign markets. A recent addition of considerable significance to lakehead commerce is the shipping of iron ore from the Steep Rock mines at nearby Atikokan.

Since the close of World War II the paper and pulp industry has expanded markedly. Other industries include shipbuilding, processing of vegetable oils, production of starch products from wheat, manufacture of lumbering and mining equipment, building of trolley and gasoline buses, sawmilling and lake fishing. With the construction of improved highways, tourism within the area is on the increase.

Regional Geographic Outline of Southeast Vancouver Island. AL FARLEY, University of British Columbia. (No Abstract received.)

The Development of the Port of Prince Rupert, British Columbia. ALISTAIR D. CRERAR, University of British Columbia. Published in full in this issue.

The Growth and Distribution of Population of Vancouver, British Columbia.
DON SOUTH, University of British Columbia.

Abstract. The site of Vancouver is a bisected rolling peninsula of glacial till. It is bounded on the north by mountains, on the west by the Gulf of Georgia and on the south and east by the Fraser River and its delta.

Good anchorage for lumber ships on the north side of the peninsula was the locational factor influencing the position of the sawmills in the primary white settlement. The terminus of the Canadian Pacific Railway was also located there because of good anchorage.

Vancouver was founded in 1886, upon the arrival of the railway. In its first year the settlement was wiped out by fire and a new one sprang up on the same site, expanding in a radial pattern from the shoreline despite the bisecting barrier of False Creek to the south.

By 1901, the population was 36,000. The city was laid out chiefly on a grid pattern and transit lines were developed on a radial plan to the west, south, and east. In the next decade the population increased almost fourfold and spread itself thinly along the transit routes which serviced what is now the city's 44 square miles.

Since 1911, the population has grown steadily. In 1946 the population of the city proper was 340,000 with another 160,000 people living in the adjacent communities. The vacant land in the city proper has nearly all been occupied and now the surrounding communities are receiving the impact of Vancouver's industrial and residential expansion. With the building of Lion's Gate Bridge, expansion on the north side of Burrard Inlet, in North and West Vancouver, has been rapid. Development to the south and east has engulfed some of the smaller communities and has produced conflict with rural land use on the Fraser River delta.

Vancouver has grown from a village of less than 1000 to a metropolitan area of 500,000 in 63 years. The city proper is almost fully occupied, with certain areas near the commercial core being rebuilt to hold a more dense population. The surrounding cities and municipalities are losing their own entities and are becoming more dependent upon Vancouver.

The Influence of the Hinterland upon the Urban Pattern of Nanaimo, British Columbia.
MARION H. MATHESON, University of British Columbia.

Abstract. Nanaimo lies on the east coast of Vancouver Island almost directly opposite the city of Vancouver across the Strait of Georgia.

The settlement was founded by the Hudson's Bay Company to exploit the coal seams discovered on a small peninsula. The pioneer community was crowded around the first mines, which accounts for the confused pattern of the present-day commercial core.

The development of coal-mining in surrounding areas opened up a small hinterland. Following local topography, the town expanded in a radial pattern. Roads radiated out to tap nearby mining areas. Many mines built their own short rail lines to the coast to ship their output. Within the town itself, the coal docks were larger than those for the handling of general freight and passengers.

The construction of the Esquimault and Nanaimo Railway and of the Island Highway enlarged the hinterland of Nanaimo to include most of upper Vancouver Island. As coal production declined in importance, Nanaimo became a regional marketing and distributing centre. The commercial area developed along the main road through the town, while industrial sites were established near the waterfront or the railroad station.

To facilitate the transshipment, truck and bus terminals have recently been established on the docks at the hub of the urban pattern. A railroad

terminal, eventually, will also be established there. Further modification of the urban pattern should result from the increased tendency of industry to migrate towards the focal point of the radial urban pattern.

Thus, changes in the size and occupance of the hinterland are modifying the urban pattern of Nanaimo yet, at the same time, are strengthening the established radial pattern upon which the town has developed.

Rocky Ford, Colorado: Cantaloupe Seed Center. M. JOHN LOEFFLER, University of Washington.

Abstract. Much of the high grade cantaloupe seed of the United States is grown in the Arkansas River Valley within a ten mile radius of Rocky Ford, Colorado. Shortly after 1900, this area was famous for the production of high quality cantaloupes. As shipping costs from the Rocky Mountain Front to Eastern markets became higher, cantaloupe production for fresh fruit was curtailed, and emphasis was placed on the production of high grade seed.

Altitude, a short growing season, high summer temperatures and maximum sunshine result in seed that is heavy, vigorous, quick-maturing and true to type. Controlled irrigation water supplements the natural rainfall and provides optimum moisture conditions for rapid plant growth. High bluffs north and south of the valley protect it from damaging winds. The valley floor alluvial terrace soils are easily worked, well drained and suitable to intensive cantaloupe culture.

The profitable seed industry owes its existence and importance to a few men who recognized the value of scientific seed selection but who also realized that the physical environment provided optimum growing and harvesting conditions for cantaloupe seed of high quality. In 1908 the Rocky Ford Cantaloupe Seed Breeders Association was organized to take advantage of this unique combination of conditions. Relatively insignificant to the local economy of Colorado, this seed business must be evaluated on the basis of its contribution to American cantaloupe-growing as a whole. This relatively limited area supplies the seed for a national industry conservatively estimated at more than 12 million dollars annually.

Regional Influences upon the Canadian Railway System. WILLERT RHYNSBURGER, Indiana University. Published in full in this issue.

Physical Geography of the Upper Peace River Area, British Columbia. J. D. CHAPMAN, University of British Columbia.

Abstract. The Peace River forms a major link in the great Mackenzie River System and, with the Liard, drains much of the Rocky Mountain Trench, north of the 54th parallel, eastwards and northwards to the Arctic Ocean.

The area of concern to this paper lies to the east of the Rocky Mountains extending from Hudson Hope to the British Columbia-Alberta boundary and some 35 miles north and south of the Peace River itself. Within this area are three main topographic levels. Plateaus with an average elevation of 2600 feet overlook gently rolling uplands varying between 2150-2500 feet, both of these features being marked by a deeply entrenched drainage system. The larger rivers such as the Peace, Kiskatinaw and Pine chiefly flow in deep canyons cut into widely flaring pre-glacial valleys.

Evidence of the work of ice is to be found throughout the area in confounding complexity, supporting the suggestion that both the Laurentide and Cordilleran ice sheets have covered the land at different times. The

almost complete covering of both sorted and unsorted drift has been partly responsible for the two major soil groups found in the area. In general the till has given rise to wooded grey soils whereas the stratified drift has slightly to strongly degraded black soils developed upon it. Although both soils have a tough, compact subsoil other characteristics differ sufficiently to suggest that they were not formed under the same climatic conditions.

Climatically the area resembles Central Alberta with some 18" average annual precipitation and 105-115 frost free days on the uplands but only 65-70 in the deeper valleys. Killing frosts may occur during the open season as Polar or Arctic air moves southward in the rear of a depression.

Utilization of the Brown Coal Deposits of Southeast Australia. GRAHAM H. LAWTON, University of Washington.

Abstract. The Latrobe Valley in Gippsland, Victoria, is estimated to contain 27,000,000,000 tons of brown coal. By generating electricity and by the manufacture of briquettes Victoria's great wealth of brown coal can compensate substantially for the State's deficiency in black coal resources. Now in use is a technique originated in Germany. Open pit mining with large dredges, electric railways and conveyor belts transport the coal to the power station and briquette factory.

The processes of briquette manufacture accomplish in a few hours what would naturally take millions of years. The raw coal is first crushed and screened. The fine moist coal is then passed through driers where its moisture content is reduced from 65 per cent to about 15 per cent. The hot, dried coal, after being cooled, is fed to the briquette presses which exert upon measured quantities a pressure of about 200 tons. This intense pressure produces, without any binding agent, small moulded blocks of hard, durable, high grade fuel. Approximately 500,000 tons of briquettes annually are being produced at the Yallourn factory from about four times that tonnage of raw coal. Finished briquettes move by rail to the supplementary power stations beyond Yallourn.

The steam electric power station at Yallourn consumes about 3-1/2 million tons of raw brown coal every year, in addition to the coal made into briquettes. It is equipped with 22 boiler units, each able to produce from 70,000 to 100,000 lbs. of steam, and each using over 30 tons of raw coal per hour. Steam at 250 lbs. per square inch pressure and a temperature of 700° F. is put through the turbines of ten electric generators, having a total capacity of 175,000 kilowatts. The major role of this one station can be judged by the fact that, for the year ended 30 June, 1947, it produced 1,181 million kilowatt-hours of electricity out of the total 1,691 million kilowatt-hours generated by all stations in the Victoria system.

Plans have been approved for an extension of open cut mining methods to the Morwell area, six miles from the existing brown coal development at Yallourn. But unlike Yallourn, where the greater proportion of the coal is utilized in its raw state for generating electricity, all coal mined at Morwell will be used for the manufacture of briquettes. Electricity will be produced at Morwell, but as a by-product.

The Morwell Project will not only provide Victorian industries with the major proportion of their solid fuel requirements within the next decade, but it will doubtless attract new industries to the Latrobe Valley and thus give a great impetus to the general development of this part of southeastern Australia.

THURSDAY AFTERNOON SESSION, JUNE 16

Resources of the Canadian Arctic. J. LEWIS ROBINSON, University of British Columbia. No abstract received, but the paper was published in full in THE BEAVER, THE MAGAZINE OF THE NORTH, December, 1949.

Environmental Influences upon British Columbia Indians. HAL ODLUM, University of British Columbia. (No Abstract received.)

Changing Scenes in Hawaii. OTIS W. FREEMAN, Eastern Washington College of Education.

Abstract. During the last two decades there have been many changes in land use and management in Hawaii. Notable advances have been made in the mechanization of agriculture, in the application of science to agriculture and industry, and in the expansion of military and other government establishments. Sugar acreage has declined by a fifth but production has been maintained by fertilizer, development of new varieties of cane and the control of insect pests by the introduction of parasites. The labor force in the sugar industry has been almost halved through the use of power equipment for planting, harvesting and handling cane. Railroads are giving way to trucks. Portable concrete ditches conserve irrigation water. In the pineapple fields machines lay mulch paper, apply fertilizer and disinfectant, and reduce the labor needed for harvesting.

New industries have developed, notably export of orchids to the mainland by air, and the growing of macadamia nuts and more vegetables than formerly. Honolulu is expanding and residences are now located on former cane fields, fish ponds and taro swamps. A mushroom growth of military establishments came in the early and middle 1940's, and great retrenchment is now occurring in this area. Salaries and wages paid to civilians by the military have been cut nearly two-thirds. It is hoped that an expanding tourist industry will provide employment for some of those released by reduced activity in other fields. However, in 1949 there were increasing numbers of people drawing unemployment compensation in the territory.

Structural and Climatic Units in the Vegetation of New Zealand. PIERRE DANSEREAU, University of Montreal.

Abstract. The physiography of New Zealand lends itself to a considerable differentiation of climate: whereas large tracts of the East Coast of the South Island have less than 20 inches of rainfall, the southern Fiordland has some 200 inches. The vegetation patterns that respond to the relatively clear-cut climatic areas are today considerably obscured by man's interference. There are many indications that degradation of the landscape here has resulted in a greater disturbance than seems generally to occur on continental areas.

The most important biochores that existed before the advent of man are referable to the following major units: (1) forests in several types: kauri, podocarp, mixed kauri-tarairi, tawa, beech, mixed beech-podocarp; (2) tussockland; (3) scabweed desert; (4) alpine scrub; (5) alpine fell-field. Whether all of these "types" are climax somewhere in New Zealand is at least doubtful. Even less clear is the geographical extent of each of them and their present trend to expansion or regression. Many different approaches to this problem must be used in order to bring it into sharper focus.

The relation of flora to vegetation is an especially interesting one, as the total flora of the islands is relatively poor and as the prevailing morphological type of many species and even genera suggests a lack of adaptation to present-day conditions which is borne out by the apparent inability of the native species as a whole to compete with European, American and Australian invaders in disturbed areas. Both by the technique of pollen analysis and by observation of the ecological behavior of present-day communities, considerable climatic shift has been detected. Furthermore, the influence of man on the especially vulnerable ecotonal areas has introduced new structures and has unequally favored the competing units.

Some Observations on "The Plow Versus the Trap" in the Historical Geography of the Pacific Northwest. WILLIS B. MERRIAM, State College of Washington.

Abstract. Ellen Churchill Semple as early as 1911 provided the historical and geographic world with the concept that the tenure of trap and trading post is a weak one when competing with a sedentary agricultural population. The historical geography of the Pacific Northwest during the first half of the nineteenth century provides a splendid testing ground for this theory.

This paper demands no new or startling conclusions. It is simply a study evaluating the factors that led to the firm title of the plow as it ousted the weaker title of the trap in the struggle for the Oregon country.

The first permanent interests in the Oregon country were based on the fur trade of the 1820's dominated by the Hudson's Bay Company. During the 1830's missionary activity from the United States dominated the scene. Religious zeal soon gave way to colonizing zeal, ushering in a decade largely dominated by the Oregon Trail migrations. This was a movement of frontier farmers which succeeded in ousting the claim of the Canadian fur economy in favor of the United States agricultural economy.

Two general conclusions may be stated: (1) the migration of American pioneers was induced by complex motives in which religious and patriotic zeal appears less important than the economic hope of bettering the condition of the immigrants; (2) The Americans were heavily favored in this movement because topography permitted them the development of the comparatively easy Oregon Trail route while the Canadians were faced with insurmountable barriers to pioneer migration by the Selkirk Mountains.

Phormium Tenax in the Economy of New Zealand. KEITH W. THOMSON, University of Washington.

Abstract. Phormium tenax is a type of flax indigenous to New Zealand. Growing in bush form up to 12 feet in height, it grows from coastal lowland to an altitude of 3000 feet. Fine, strong fibres obtained from the knife-like leaves are suitable for various purposes. To the pre-European Maoris it was one of their chief economic plants. Phormium tenax was the first article used by the Maoris in barter with Europeans who used the fibre for rope making. The Maori desire for firearms led to careful selection and cultivation of the best varieties.

European planters began phormium tenax cultivation in the middle of the 19th century and introduced a mechanical stripper. Machine processing has not yet produced fibre equal in quality to that of the native hand industry. Large areas of swamp were drained for agricultural purposes, and a period of flax exploitation followed during the years 1890-1930.

Several reasons account for the decline of the industry in the decade following World War I. The rise of standardized sisal in the late 1920's

lessened the export of the then unstandardized phormium. Lowered water levels in the swamp lands caused the phormium plantings to suffer. A yellow leaf disease seriously damaged many of the larger plantations.

Recent government attempts to resuscitate the industry in the swampier lands near Foxton have met with some success. Extensive research is being carried on. Eighteen producing districts throughout both islands supply less than half the fibre required by the potential domestic market. Working below capacity, the enlarged establishment of the New Zealand Woolpack and Textiles mill at Foxton produces high quality sacking and floor matting.

In the earlier periods phormium tenax fibre was New Zealand's principal export, but gradually it was superseded by timber and later by animal products. Flax production will never regain its past dominance, but with further technical advances in milling processes it should again become a significant New Zealand industry.

The Ahuriri Lagoon, New Zealand: A Study of an Evolving Habitat.
BRYAN H. FARRELL, University of Washington.

Abstract. The Ahuriri Lagoon, a shallow body of water occupying approximately twelve square miles, was located three miles north of the town of Napier on the East Coast of the North Island of New Zealand.

On February 13, 1931, the Hawkes Bay earthquake elevated the lagoon floor about five feet, exposing some 3000 acres of land. Three years later drainage work commenced and by 1936 a network of ditches covered most of the exposed area. Surplus water was pumped into an outflow and discharged into the harbor at Port Ahuriri. Twenty-six miles of metalled roads and eighty miles of fencing were constructed by government authorities. Experimental agriculture was undertaken to ascertain the suitability of the land. Soils were high in available mineral plant foods but excessive salinity necessitated the digging of 354 miles of desalting drains. The first salt tolerant pioneer vegetation was succeeded by less tolerant species. By 1937 sheep were being grazed on this mixed indigenous and exotic plant cover.

Today the 7500-acre Ahuriri Lagoon Farm, with an effective area of 5500 acres, is operated by the New Zealand Government. With about 1200 acres planted to high quality English grasses, the farm winters over 13,000 head of sheep. It produces excellent meat animals, and satisfactory grain and hay crops. Agricultural problems include sea-water seepage, soil salinity, copper deficiency, lack of shelter for livestock and a too rapid multiplication of the rabbit population.

The area is in contrast to the adjacent, intensively farmed, Heretaunga Plain, the core of Hawkes Bay Province. The Lagoon Farm presents a green-grey landscape dominated by straight and parallel fences, drains and roads, set upon a level, treeless expanse. In a country where fertile lowland is at a premium, a not insignificant area is being developed for settlement consequent upon the uplift, while nearby hill country deteriorates through the ravages of culturally induced erosion.

THURSDAY EVENING SESSION, JUNE 16

Annual Dinner, Faculty Club, University of British Columbia. Address of the retiring President: Mother Lode, 1949. RUTH E. BAUGH, University of California at Los Angeles. Published in full in this issue.

FRIDAY MORNING SESSION, JUNE 17

Zuid-Limburg: The Highlands of Holland. ANTHONY SAS, University of Washington.

Abstract. Zuid Limburg, located in the far southeastern corner of the Netherlands, differs in many respects from the rest of the country. The rolling landscape of this "panhandle" is in marked contrast with the flatness and lowness which characterizes the greater part of the Dutch landscape. The customs and way of life of the people are more closely related to the German Ruhr area and to Eastern Belgium than to the Dutch core area northwest of the Meuse River. Racially, the people are mainly of the Alpine type; the dominant religion is Roman Catholic.

Historically, Zuid Limburg was one of the first settled areas of the Netherlands and throughout history it has played an important role due to its crossroads location between northern Germany, France and Belgium.

The economy of Zuid Limburg is based upon coal mining and related industries, tourism, agriculture, and manufacturing. Coal mining, which got its real start with the enactment of the Mining Law in 1902, dominates the activities of the greater part of the population as well as the economy. The annual production in 1948 was approximately 13 million tons of bituminous coal.

Due to its rolling terrain, Zuid Limburg ranks high among Dutch tourist centers. Agriculture, the oldest occupation in the area and mainly carried out in the southern part, ranks next in importance, while manufacturing is of significance in the capital city of Maastricht.

Zuid Limburg's future is inevitably tied up with its coal reserves which for the next 50 years at least will be sufficient for Dutch needs. Manufacturing and agriculture will probably hold their own, but tourism is expected to become of greater importance due to better accommodations and increased propaganda.

The New Role of Geographers in Britain. L. DUDLEY STAMP, London School of Economics.

Abstract. In Britain, as in very many of the countries of the Old World, the crucial shortage is a shortage of land. England and Wales, for example, have only 37 million acres to serve all the needs of 44 million people and the area of productive farmland is only a little over half-an-acre per head of population. Consequently Britain has now a Ministry of Town and Country Planning, charged with the preparation of development plans for every part of the country, the aim being to direct housing and industrial development wherever possible on to poorer types of land and to conserve the better land for food production.

The Ministry has both its administrative and research staffs. The actual plans are being prepared on a county basis. In each county there is now a Planning Officer with appropriate staff, including Research Officers, whose work is to carry out detailed surveys, to evaluate geographical and other factors which have contributed to the present position and which will operate in future development. All this provides an immense new field of work for trained geographers, especially on the research side. It is work which requires both knowledge and judgment and there is a marked shortage of first-class University-trained men and women for the purpose.

Sustained Yield Forestry in the Puyallup Valley, Washington. JOHN C. SHERMAN, University of Washington. Published in full in this issue.

FRIDAY AFTERNOON SESSION, JUNE 17

Snowdrift Conditions in the Palouse, Eastern Washington. W. A. ROCKIE, United States Department of Agriculture.

Abstract. The Palouse Region is chiefly in southeastern Washington but extends into northern Idaho. It is a wheat-pea farming region where extremely steep slopes are farmed. Practically all of the land is in cultivation.

The area has a modified maritime climate. The winters are typically cloudy with considerable rain and snow while the summers are generally clear with little or no rain. Precipitation ranges from about 14 inches at the western edge to about 25 inches at the eastern border next to the mountains. Strong southwest winds, high humidity and below-freezing temperatures characterize much of the winter period. Occasional chinooks break the sustained winter cold with spells of mild weather. The high latitude and the resulting low incidence of the sun contribute to the development of snowdrifts. Winter snowfall attains its greatest volume and southwest winds attain their maximum mileage in this general latitude.

The topography is a rather completely dissected plateau, rising in elevation from 1500 to 1800 feet along its western edge to about 2600 to 2800 feet along its eastern border. It has virtually no undissected upland but also is almost without alluvial bottom lands. The land is practically all sloping. South and west slopes are universally of more gentle gradient than are the north and east slopes.

A composite result of these conditions is the development of extremely large snowdrifts on leeward slopes in the Palouse. These drifts attain considerable magnitude and assume fantastic shapes. The snowdrifts are a distinct hazard to reliable all-year transportation because they sometimes defy man's efforts to keep highways passable.

The excessive drifting of the snow mantle in effect shifts the hilltops and upper south slopes to a more arid site condition. By the same token, the leeward slopes are shifted to a more humid condition and that part of the leeward slope where the snowdrift lies is shifted to a highly humid microclimate. To illustrate: the precipitation at Pullman is 20.8 inches. But snow equivalent to at least six inches of water almost always blows off the hilltops, and about one-third of the preciptation received as rain, or 4-5 inches, drains away at once. The clay hilltops, therefore, actually have only about ten inches of preciptation to divide among percolation, evaporation and transpiration. The snowdrift site on the other hand gets the 20.8 inches natural precipitation plus 40-80 inches of water in the form of drift snow. All other sites on a Palouse hill fall somewhere between the above extremes, and the Palouse hill landscape has many different effective precipitation regimes on its several situations.

Cultivation of these lands provides an increased hazard to the permanence of the current agriculture and so far as present observations have gone, conversion of the hilltops and steep leeward snowdrift sites from wheat and peas to trees, shrubs or grass-legume cover is essential to prevent accelerated erosion.

Asymetrical Weathering and Erosion of Western Mountain Ridges. JOSEPH E. WILLIAMS, University of Washington. (No Abstract received.)

Geographic Obstacles to Economic Rehabilitation of the Trust Territory of the Pacific Islands. J. L. TAYLOR, Stanford University.

Abstract. Strewn over the west central Pacific Ocean are the 1400 islands and islets comprising the Trust Territory of the Pacific. Since July, 1947, this entire three million square mile area, formerly called the Japanese Mandated Islands, has been administered by the United States. Under the United Nations Trusteeship Agreement the United States is obligated to:

> Promote the economic advancement and self-sufficiency of the inhabitants, and to this end shall regulate the use of natural resources; encourage the development of fisheries, agriculture, and industries; protect the inhabitants against the loss of their lands and resources, and to improve the means of transportation and communications.

Administrative offices are scattered from Hawaii to Palau.

Numerous geographic obstacles confront the United States in rehabilitating the Trust Territory. Chief among them is the great distance of the trust region from the United States which increases the cost and time consumed in transportation of supplies and equipment essential to the restoration of a pre-war economy. The islands are so scattered and have such limited natural harbor facilities as to create barriers to inter-island activity. Natural resources are severely limited in number and variety. The islands possess an enervating climate which is not conducive to the hard work necessary to make them productive. Numerous insects and pests ravage crops and livestock to such an extent that they are real problems. In terms of present population and level of economic needs and habits, there are limited opportunities for future expansion and development.

In spite of these handicaps real progress is being made towards rehabilitation and revitalization of island economy. The Island Trading Company and the Civil Administration are sponsoring subsistence and commercial agriculture, fishing, handicrafts and light industries and varied commercial activities. In an attempt to clarify the extremely complicated land tenure system in the Trust Territory a staff of legal specialists, surveyors and draftsmen are engaged in unraveling pre-war claims, and also the extensive holdings acquired for military purposes.

However, the islands cannot be expected to be self-supporting in the sense of producing public revenues for maintenance of necessary administrative and welfare services at levels satisfactory to American standards. In this respect, the islands are a liability and an inevitable charge on the national purse.

Geography in Flight. G. ETZEL PEARCY, Transworld Airlines, Kansas City, Missouri.

Abstract. Seeing the earth from an airplane has special appeal to the geographer. Countless studies may be made of land forms, natural vegetation, land utilization, urban development, transportation, and other features involving spatial relationships. A flight between Kansas City and Denver can illustrate the transition between the humid land farming of eastern United States and the dry-land practices of the semiarid west. Or a flight across the Nile Delta will give one an excellent picture of agricultural activities in that crowded region.

From high altitudes a geographer must adapt his powers of observation. Patterns appearing through a plane window differ from the detail common to surface travel. At 20,000 feet elevation over the winter wheat belt of southwestern Kansas highways mark off the countryside into one-mile squares for as far as the eye can see--and that may be Oklahoma. Percentage of land use can readily be calculated, and railroads can be traced through towns and villages that provide marketing facilities for the

wheat farmers. Colors indicate the status of the leading crop: browns for the land in fallow, greens for the planted land, with buff the harvest or stubble color.

At high altitudes the landscape presents paradoxes. It is impossible to tell a field of corn from a field of grain, but a poor job of plowing shows up. A house cannot be told from a barn, but the smallest pond is readily recognized. In a semiarid region even a wagon trail is easily seen, but try to find herds of sheep or cattle grazing. Slopes as a third dimension can, with a little practice, be discerned by erosion marks, stream patterns, and vegetation transitions.

A routine trip in a commercial airliner may serve well for such enlightening studies, assuming careful planning by the geographer. The larger the plane the greater the field of vision, but the less the detail. Because of great speed there is but little time to view any stretch of landscape, therefore it is necessary to know beforehand as much as possible about the land over which one is to fly.

The Hop Production of the Pacific Coast States. ELBERT E. MILLER, University of Utah.

Abstract. Whereas formerly most of the hops grown in the United States were grown in the eastern and central parts, the three Pacific Coast states now cultivate 40,000 acres annually as compared to about 600 acres in the remainder of the country. The industry grosses over $35,000,000 annually for the farmers of Washington, Oregon and California.

As production first shifted to the Pacific Coast, the Willamette Valley of Oregon became the most important producing area. However, within the past 20 years acreage and production have decreased there and are rapidly increasing in Washington and California. From 1940 to 1945 acreage increased 205% in the Yakima Valley of central Washington which now leads in production and yields per acre. The floodplains of the Sacramento River and its tributaries are important producing regions in California. In 1947, California produced 13,600,000 pounds of dry hops from 9000 acres; Oregon grew 16,000,000 pounds on 19,000 acres; and Washington marketed 20,500,000 pounds from its 12,000 acres.

Reasons for the shift of production to the Yakima Valley and Sacramento Valley appear to be numerous and difficult to evaluate. However, disease, climate (especially preciptation and humidity), fertilization, size of farms, mechanization, soils, labor, prices, varieties, the practice of growing pollenized (seeded) hops, and spacing of plants in the fields all seem to be significant in causing the Willamette Valley to have yields about half that of the other areas. This paper will be published in full in the JOURNAL OF GEOGRAPHY.

Prince George, British Columbia, A Preliminary Urban Study. CHARLES H. HOWATSON, Victoria College, Victoria, British Columbia. (No Abstract received.)

Geography for Adults. HAZEL R. NEWHOUSE, Portland Oregon Public School System. (No Abstract received.)

Saturday Morning Field Trip, June 18

Field Excursion in and around the city of Vancouver, British Columbia. Leader: J. Lewis Robinson, University of British Columbia.

Abridged Report of the Secretary-Treasurer

June 17, 1949

As of June 17, 1949, there were 163 Association members, an increase of 18 members during the year.

Two Newsletters were mailed to members during the year.

Yearbook Editor John B. Leighly resigned upon the completion of Volume 10 of the Yearbook.

Income Deposits*		Income Withdrawals	
Opening Balance	$429.24	Stamps	$10.50
Royalties	30.00	Office Supplies	16.27
Dues	350.50	Secretarial Help	45.00
Donations	15.00		
Yearbook Sales	10.00	Total	$ 71.77
Total	$834.74	Bank Balance	$762.97

Subsequent to this report the Secretary-Treasurer reported publication costs for Volume 10 of the Yearbook as $555.45.

Officers, 1949-50

President, John E. Kesseli, University of California, Berkeley.

Vice-President, J. Lewis Robinson, University of British Columbia, Vancouver.

Secretary-Treasurer, V. Calvon McKim, Fresno State College, Fresno, California.

Editor, J. E. Spencer, University of California, Los Angeles.

*Between the Treasurer's report of June 1, 1948, printed in Volume 10 of the Yearbook, and the opening balance of the current report the Secretary-Treasurership changed hands and a period of twenty-one days elapsed. In the interval income amounting to $30.80 was received but cannot now be classified per categories listed.

A Regional Bibliography of Articles and Abstracts in The Yearbook of the Association of Pacific Coast Geographers Vols. 1-10, 1935-48

J. Lewis Robinson

University of British Columbia, Vancouver

I	Alaska	XVII	Eastern United States
II	Arizona	XVIII	United States, general
III	British Columbia	XIX	Northern Canada
IV	California	XX	Pacific Ocean and Islands
V	Colorado	XXI	Africa
VI	Montana	XXII	Antarctica
VII	New Mexico	XXIII	Asia
VIII	Oregon	XXIV	Australia and New Zealand
IX	Texas	XXV	Central America and Caribbean
X	Utah	XXVI	Europe
XI	Washington	XXVII	South America
XII	Wyoming	XXVIII	Geography, general
XIII	Pacific Coast and Northwest, general	XXIX	Agricultural Geography, general
XIV	Southwest, general	XXX	Climate, general
XV	Great Plains	XXXI	Physiography, general
XVI	Middle West		

Items are arranged chronologically within each regional unit. Abstracts are indicated by the abbreviation (abs.) after the title.

Alaska

1. Historical Geography of Russian America, by Willis B. Merriam, p. 18, 1937.
2. Development and Possibilities of an Alaskan Livestock Industry (abs.), by W. T. White, p. 39, 1940.
3. The Function of Water Transportation in the Alaska Salmon-Canning Industry (abs.), by Robert N. Young, p. 35, 1947.
4. The Alaskan Taku Wind (abs.), by Carol C. Beamer, p. 38, 1947.
5. The Seward Peninsula of Alaska (abs.), by Howard J. Critchfield, p. 49, 1948.

Arizona

1. Development and Sites of the Papago Villages of Arizona and Sonora (abs.), by J. W. Hoover, p. 23, 1935.
2. The Papago Villages of Arizona and Sonora; Types and Sites (abs.), by J. W. Hoover, p. 28, 1938.
3. The Geographic Setting of the Middle Rio Verde Valley (abs.), by Agnes M. Allen, p. 31, 1938.
4. Cerros de Trincheras in the Papago Country of Arizona (abs.), by J. W. Hoover, p. 34, 1939.
5. Havasu Canyon and the Havasupai Indians (abs.), by J. W. Hoover, p. 49, 1941.

British Columbia

1. The Influence of the Canadian Selkirks on the Westward Movement (abs.), by Joseph T. Hazard, p. 40, 1940.
2. Some Environmental Influences in the Cultural Development of the Haida, by Willis B. Merriam, p. 23, 1942.

California

1. The Italian-Swiss Dairymen of San Luis Obispo County, by H. F. Raup, p. 3, 1935.
2. The Human Ecology of Baja California, by Forrest Shreve, p. 9, 1935.
3. Historical Geography of Northern Lower California, by Peveril Meigs, p. 14, 1935.
4. Land Utilization in the Northern Santa Clara Valley (abs.), by E. N. Torbert, p. 18, 1935.

5. Lima Bean Farming and Soil Erosion in the Encinitas Area, by George F. Carter, p. 15, 1938.

6. Water Planning in the Great Central Valley, by Peveril Meigs, p. 25, 1938.

7. Geomorphology from Detailed Geological Mapping, Western San Gabriel Mountains (abs.), by Gordon B. Oakeshott, p. 30, 1938.

8. The Origin of the Valley of June, Gull and Silver Lakes, Mono County (abs.), by John E. Kesseli, p. 33, 1939.

9. Notes on Population Changes in the Coast Ranges of Northern California (abs.), by J. O. M. Broek, p. 38, 1939.

10. The Landslide near Sargent, California, by Walter A. Hacker, p. 38, 1939.

11. Piedmont Plain Agriculture in Southern California, by H. F. Raup, p. 26, 1940.

12. The City of Fresno (abs.), by Elizabeth Schreiber, p. 38, 1940.

13. Rock Streams in the Sierra Nevada (abs.), by John E. Kesseli, p. 40, 1940.

14. Land Forms of the San Gabriel Mountains, by Joseph E. Williams, p. 16, 1941.

15. Wind and Trees, by R. W. Richardson, p. 41, 1941.

16. Areal and Annual Variations of Climatic Types in California (abs.), by Arch C. Gerlach, p. 50, 1941.

17. Maps of Current Trends in California Orchards and Vineyards (abs.), by Peveril Meigs, p. 50, 1941.

18. The Site of Early Los Angeles (abs.), by Ruth E. Baugh, p. 50, 1941.

19. The Occurrence and Use of Black Sand from Beaches and Terraces at Monterey Bay (abs.), by Charles N. Beard, p. 51, 1941.

20. The California Mapping Plan (abs.), by Willis H. Miller, p. 52, 1941.

21. San Francisco, 1846-1946 (abs.), by H. F. Raup, p. 33, 1947.

22. Land Forms and Land Use on the Eastern Shore of Monterey Bay (abs.), by Charles N. Beard, p. 40, 1947.

23. The Leonis Valley-Elizabeth Lake Area, a Part of the San Andreas Fault Zone (abs.), by June Carroll, p. 41, 1947.

24. The Rainiest Month in California (abs.), by John Leighly, p. 41, 1947.

25. Problems of Recreational Use of Lake Elsinore (abs.), by Robert W. Pease, p. 43, 1947.

26. The Greenhouse Flower Industry of the San Francisco Bay Area (abs.), by Donald I. Eidemiller, p. 45, 1947.

27. Land Utilization in the Livermore Valley (abs.), by David Lowenthal, p. 43, 1948.

28. The Normal Annual March of Precipitation in California (abs.), by John Leighly, p. 45, 1948.

29. A Terrain Sample of the Sierra Crest Region (abs.), by David H. Miller, p. 46, 1948.

30. Industrial Development of the San Francisco Bay Area (abs.), by James J. Parsons, p. 48, 1948.

Colorado

1. A Physiographic Expression of the Indian Creek Plutons of the Denver Mountain Parks Region (abs.), by Margaret F. Boos, p. 30, 1937.

2. The Urban Pattern of Denver, Colorado (abs.), by M. F. Boos and H. E. Winchester, p. 33, 1937.

3. The Range Cattle Industry of Northwestern Colorado (abs.), by Kay DeKraay, p. 41, 1940.

4. Denver, an Urban Analysis (abs.), by Howard H. Martin, p. 33, 1947.

5. The Environmental Factor of High Altitude at Climax, Colorado (abs.), by John H. Thompson, p. 37, 1947.

Montana

1. Land Utilization in Judith Basin (abs.), by A. Russell Oliver, p. 16, 1937.

New Mexico

1. The Development of Meanders in Intermittent Streams (abs.), by John Leighly, p. 25, 1935.

2. Sites of Prehistoric Community Houses in the Chaco Canyon Region (abs.), by Malcolm Bissell, p. 48, 1941.

Oregon

1. Geonomics of the Rogue River Valley (abs.), by Willis B. Merriam, p. 24, 1935.

2. Studies in the Urban Geography of Portland (abs.), by Norman Carls, p. 37, 1940.

3. Historical Geography of the Rogue River Valley (abs.), by Willis B. Merriam, p. 41, 1940.

4. Regional Basis for Population Increase of the Corvallis-Albany Urban Centre (abs.), by J. Granville Jensen, p. 42, 1947.

5. The Geography of Eugene (abs.), by Warren D. Smith, p. 48, 1948.

Texas

1. Historical Geography of the Gadsden Purchase (abs.), by Joseph T. Hazard, p. 24, 1936.

2. Adjustments to the Climate of the Llano Estacado Region of Texas, by Darthula Walker, p. 10, 1937.

Utah

1. The Geographic Factor and its Influence on Utah Administrative Units, by George H. Hanson, p. 3, 1937.

2. Modification of the Early Utah Farm Village, by Joseph A. Geddes, p. 15, 1942.

3. Influence of Geography on Population Trends in Utah (abs.), by George H. Hanson, p. 27, 1942.

4. Geologic Factors in the Settlement and Development of Utah (abs.), by Hyrum Schneider, p. 27, 1942.

5. The Houses of Southern Utah (abs.), by Joseph E. Spencer, p. 28, 1942.

Washington

1. The Hop Industry of the Yakima Valley (abs.), by Otis W. Freeman, p. 8, 1935.

2. Migratory Work Waves in the Skykomish Valley, by Leonard C. Ekman, p. 5, 1936.

3. Population Growth in the Puget Sound Region, by Carl H. Mapes, p. 15, 1936.

4. Industrial Seattle (abs.), by Howard H. Martin, p. 18, 1936.

5. Climates of the Puget Sound Lowland (abs.), by Phil E. Church, p. 19, 1936.

6. Physiography of Western Washington (abs.), by Howard A. Coombs, p. 20, 1936.

7. Anthropogeography of the Cascade Highlanders (abs.), by Claude W. Cox, p. 21, 1936.

8. Commercial Seattle (abs.), by Albert L. Seeman, p. 23, 1936.

9. Agricultural Trends in Western Washington (abs.), by Frances M. Earle, p. 25, 1936.

10. The Forest Situation in Western Washington (abs.), by Willis B. Merriam, p. 28, 1936.

11. The Cut-Over Land Situation in Western Washington (abs.), by J. Allen Tower, p. 29, 1936.

12. The Occupance and Abandonment of Tye - A Cascade Mountain Community (abs.), by Leonard C. Ekman, p. 28, 1937.

13. The Structure of Summer Wind Over San Juan Island, Wash. (abs.), by Carol C. Beamer, p. 31, 1937.

14. Physiographic Divisions of the Columbia Plateau, by Otis W. Freeman, p. 12, 1940.

15. Type Curves and Duration of Snow Cover in Washington, by Phil E. Church, p. 21, 1940.

16. Factors in the Growth of Everett (abs.), by Leda Hamilton, p. 37, 1940.

17. Industrial Tacoma (abs.), by Gertrude L. McKean, p. 38, 1940.

18. Tri-functional Urbanization at Grand Coulee Dam (abs.), by Harold E. Tennant, p. 39, 1940.

19. Geography of Pend Oreille County (abs.), by Ernestine Hamburg, p. 43, 1940.

20. Agro-geographic Adjustments in the Wenatchee Valley (abs.), by Howard Pepke, p. 44, 1940.

21. The Range Sheep Industry of Kittitas County (abs.), by R. M. Shaw, p. 44, 1940.

22. Changes in Land Use in the Pullman-Moscow Section of the Palouse Wheat Area (abs.), by Harold H. Rhodes, p. 45, 1940.

23. A Study of Vashon Island (abs.), by Chester F. Cole, p. 45, 1940.

24. The White River Valley of Washington (abs.), by W. Ross Pence, p. 45, 1940.

25. The Cranberry Industry of Western Washington (abs.), by Albert L. Seeman, p. 46, 1940.

26. Wild Plants and Minor Forest Products of Western Washington (abs.), by Woodrow Clevinger, p. 47, 1940.

27. Glacial Features and Glacier Recession in the Upper Lake Chelan Region (abs.), by Otis W. Freeman, p. 49, 1941.

28. Development of the Columbia Basin Reclamation Project, by Otis W. Freeman, p. 15, 1947.

29. The Evolution of an Olympic Peninsula Timber Town: Shelton (abs.), by Margaret Carstairs, p. 34, 1947.

30. Indian Fishing Rights in Washington and Their Effect on Salmon Conservation (abs.), by Tim K. Kelley, p. 34, 1947.

31. Irrigation Agricultural Specialties in the Yakima Valley (abs.), by Richard M. Highsmith, p. 35, 1947.

32. The Geography of State Parks: A Comparison Between Indiana and Washington (abs.), by Otis W. Freeman, p. 36, 1947.

33. Temperatures in the State of Washington as Influenced by the Westward Spread of Polar Air Over the Rocky and Cascade Mountain Barriers (abs.), by T. Edward Stephens, p. 37, 1947.

34. Land-Use Planning and the Colville Valley (abs.), by Francis J. Shadegg, p. 42, 1948.

35. Duwamish River: Its Place in the Seattle Industrial Plan (abs.), by S. Lucile Carlson, p. 47, 1948.

Wyoming

1. Old Faithful, an Example of Geyser Development in Yellowstone Park (abs.), by C. M. Bauer and G. Marler, p. 45, 1939.

Pacific Coast and Northwest, general

1. Geography in the Secondary Schools of the Pacific Coast States (abs.), by James F. Chamberlain, p. 21, 1935.

2. A Modification of the Koppen Criteria for Determining Seasonal Distribution of Precipitation (abs.), by Anna M. Boschen, p. 26, 1935.

3. Production Trends in the Northwest Fisheries (abs.), by Enid L. Miller, p. 22, 1936.

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